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ELECTRICAL REVIEW.

VOL. LXXXVI. JUNE 11, 1920. No. 2,220.

ELECTRICAL REVIEW.

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SCIENCE AND INDUSTRY.

Science states that Dr. Van H. Manning, Director of the U.S. Bureau of Mines, has resigned his post to take the position of Director of Research with the American Petroleum Institute, after 34 years' service. In his letter of resignation he points out that within the last few years it has been impossible for many men to remain in Government service; the competition of industry is taking the highly trained men of the scientific bureaus at salaries which the Government does not pay, or even approach.

Dr. Fred. G. Cottrell, Assistant Director, has been nominated by President Wilson to fill the vacancy; his process (based on the Lodge process) for precipitating fumes and dust is in world-wide use, but he assigned his patents to a non-dividend paying body, the Research Corporation, in order to encourage scientific research.

Prof. E. F. Nichols, of Yale University, has also resigned his post, to become the Director of Pure Science in the Nela Research Laboratory of the National Lamp Works of the General Electric Co., at Cleveland, U.S.A. He remarks that "the position offers complete freedom in the choice of research problems, and places at my unhampered disposal such human and material resources as no university I know of can at present afford. . . . The heightened opportunities of the new position are in everything else so advantageous, that the offer becomes finally irresistible."

Here is matter for earnest thought. Scientific experts are being welcomed with open arms—and purses—in the industrial world of the United States; the academic profession and the Government alike are unable to make it worth their while from any point of view to disregard the voice of the charmer. And be it noted that Prof. Nichols has a free hand to undertake *any* research in pure science that he thinks fit. This is very significant; it is not, however, surprising, for the General Electric Co., U.S.A., has proved beyond doubt that pure scientific research pays it handsomely. It would, on the other hand, be exceedingly surprising if any firm in this country adopted such a policy. We do not say this in a fault-finding spirit; we know only too well that circumstances in the past have not permitted of the adoption of so enlightened a policy. There is, however, a certain tendency to emphasise the importance of "industrial research" at the expense of "scientific research," a distinction of which we do not altogether approve; by the former is meant research which is obviously utilitarian, while by the latter is denoted research without an immediate utilitarian objective, research for the pure love of research, but obviously "research" which is not scientific is not worthy of the name.

Returning from this digression, we wish to point out that in this country also scientific men are leaving the employment of the Government and of teaching institutions for appointments in connection with industry. This is an excellent thing for industry at the moment; but it is a very serious matter for our scientific institutions in the present, and for industry in the near future. The teaching profession, always underpaid in this country in normal times, and now absolutely starved, is in danger of losing

its scientific staff, and the students, who were never nearly so numerous as now, are in danger of being left without competent instructors. What that means to industry is only too plain.

Here again we have to face new conditions, brought about by the Great War. Industry now recognises the value of scientific training—colleges and universities are in urgent need of funds to make good the fall in value of the currency, and to provide for larger numbers of students. The key to the whole situation is, as usual, a golden one. If the universities and colleges are to be in a position to supply the demands of industry for scientifically-trained men, industry must supply them with the means. It will be a profitable investment, and the need is so pressing that delay will involve the gravest consequences.

The All-Electric House.

In our last two issues we have published articles describing, on the one hand, experience obtained by the Glasgow Corporation electricity department in the use of electricity for all domestic purposes—lighting, heating, and cooking—in two houses, over a period of one year; and, on the other, a complete installation from the source of energy to the consuming apparatus in a large country house, which, together with the estate cottages and offices, has been equipped for "all-electric" operation. These articles are of exceptional interest at the present time, when the merits of electricity are being closely scrutinised and debated by unfriendly critics, and are about to be discussed at a special meeting of the Institution of Electrical Engineers.

Regarding the latter example, it is, of course, somewhat exceptional; not many estates have at command 150 H.P. But there are many places where 10 to 20 H.P. could be obtained, and this would be ample for most requirements, with the aid of a storage battery. What can be done in this direction was well shown in the article by Mr. Thomas Smith in our issue of August 30th, 1918, in which he gave some particulars of 273 water-power electric installations carried out in 10 years in Wales by a single firm, the power developed ranging from 2 to 27 H.P. Complete records are being kept of the operation of this all-electric equipment, and we hope that eventually they will be available for publication; we understand that they are extremely interesting.

The former instance, however, is of much wider application, and deserves close study. The author, Councillor Denny, states that conclusive confirmation has been obtained of the fact that the domestic load is better distributed throughout the day, and may become far more important, than the power load, while if combined with the existing load it would greatly improve the load factor.

The advantages gained by the consumer by the use of electricity for all purposes are too well known to our readers to call for recapitulation here; they are obtained at a total annual cost for energy of £32 to £35 per house, which could certainly be reduced, as the author points out, by one-third if the domestic load were developed, and would then involve no great increase over the cost of coal and gas. We were about to say "for equivalent service," but this would be wrong; coal and gas cannot by any possibility render service equivalent to that of electricity, but they can, and do, introduce an intolerable amount of dirt, dust, labour, and pollution of the atmosphere, all of which have to be paid for in terms of health and pocket. Could these items be accurately costed, we have no doubt at all that the actual inclusive cost of the electrical supply would come below that of its grimy rivals—or rather, competitors, not rivals.

As we have said before, paper calculations regarding thermal units, &c., are incapable of demonstrating the facts in the comparison; they deal with only one aspect of the subject, and they entirely fail to take account of factors which cannot be neglected, not least of which is the great saving of labour effected by electrical methods. Public opinion does take these factors into account, and there is no room for doubt as to its verdict.

"Situations Vacant."

Last week we commented on the defects of the customary practice in connection with the filling of appointments which have been advertised in our pages, and urged that unsuccessful applicants ought not to be left in the dark as to the result of their applications. We might have mentioned that some of our advertisers in such cases notify the fact that a post has been filled, and courteously convey their thanks to those who have answered the advertisement by means of an announcement under the heading "Appointments Filled"; but human nature being what it is, the thought that our attitude was not altogether disinterested might have suggested itself to the cynical reader—if any of our readers are cynical.

We have, however, found a solution to the problem which we hope will commend itself to both advertisers and applicants. Our advertisement department has arranged to insert, free of charge, notices stating that specified appointments have been filled. An announcement to this effect appears in our advertising pages to-day, and in the interests of applicants we trust that advertisers will make use of this method of closing correspondence, which will involve the minimum of effort and expense while, we believe, fully meeting the needs of the case.

An Imperial University?

The demand of the Imperial College of Science and Technology for university status and the power to confer degrees was further pressed at a public meeting in London on Friday last; the audience consisted mainly of students, and several eminent men gave addresses in support of the claim. The Imperial College is independent of the University of London, but is recognised as a school of the University, so that its students may take the "internal" degree. It is pointed out that the diplomas of the College, while of deservedly high repute, do not carry the same weight as a University degree, which is recognised as a "hall-mark," and has a commercial value.

It cannot be denied that there is room for more than one University in London; three or four universities would not be too many for a population of seven millions. But what is a university, and what is the meaning of a university degree? It is not now given to any man to study all branches of knowledge, and even in a university specialisation is inevitable, but at least a university must provide instruction in all those subjects which are embraced in a liberal education, and afford facilities for the absorption of that general culture which is the only sound foundation upon which to erect a superstructure of specialised knowledge. Essential elements of that culture are the study of mankind, and the polish which is imparted by constant association with one's fellows in the atmosphere inherent to a university, where all are equals and comrades.

In those functions of a university the Imperial College is unquestionably deficient, at present; it makes no claim to teach the "arts," or, rather, the "humanities," a term which has been falsely arrogated to classical studies, but which in truth denotes "the highest and most harmonious culture of all the human faculties and powers" (Trench, *On the Study of Words*). We are not finding fault with the College on this score; on the contrary, we have the highest admiration and respect for it as a truly Imperial College of Science and Technology, an institution worthy of its great calling as the scientific focus of the Empire. But it is not at present organised or equipped to fulfil the functions of a university: what guarantee have we that, if endowed with authority to confer degrees upon its alumni, the new university will develop itself into a university in fact as well as in name?

That is the sole consideration which deters us from supporting the claim of the Governing body, the staff, and the students. In the absence of that development, the College will remain a College, while it becomes a pseudo-university, its degrees will be technological diplomas in disguise, and its graduates will lack breadth of culture.

THE GLORY OF THE DAY'S WORK.

By "FEMINA."

It is said that Walt Whitman, on seeing some labourers returning from their daily toil, exclaimed to his friends: "Ah, the glory of the day's work, whether with hand or brain!" Whatever may be thought of Walt Whitman's poetry, one cannot help feeling that it came from his heart; and as, according to an Arab proverb, he who speaks *from* the heart speaks *to* the heart, we may be sure that this utterance of his met with a ready response from all those who were working heart and soul, in any way whatever, to make America the great power in the world she is to-day. The greatest nation that this world will ever know will be the nation that feels in its inmost soul that the day's work, faithfully and conscientiously performed by every one of its people, man, woman and child, is indeed a glorious thing. This truth must be brought home to every worker, from the humblest drudge to the most gifted genius, before any nation can become in reality one of the Great Powers of the World.

The great masterpieces of the world are silent witnesses to the fact that this sense of glory existed in the past, and we have only to turn to the Old Testament to see that it was "as a burning fire" in the heart of the Jewish nation. I may quote as instances the making of the Tabernacle, the building of the Temple and the rebuilding of the Wall of Jerusalem. I suppose that in England to-day the majority of employers and workers would regard as idealistic nonsense the idea of there being any glory about the day's work—the idea of work for work's sake, for the sake of the prosperity of the industry, the prosperity of the country. They have become more accustomed to Mr. John Masefield's "ring o' roses" point of view: "'Men work to get enough to eat, so that they may have strength to work to get enough to eat." Yet this glory has not really departed, any more than the sun departs from the heavens during a dense fog or a thunderstorm. It shone clear and undimmed during the war, although darkness has returned to the national soul since.

"There is no sentiment in business" we are told by both employers and employed, but then most popular catchwords are either fallacies or half-truths. We cannot afford to disregard the spiritual factor in industry or anything else, for it is the vital principle.

If this sense of glory once became general it would solve automatically many labour problems. The account in the Book of Nehemiah of the rebuilding of the Wall of Jerusalem is well worth studying by both employers and workers to-day, for it is a splendid story of a great engineering feat, a mighty effort made under great difficulty and in the face of the most strenuous opposition. We read that not only were the workers protected by armed guards, but the builders had their swords girded on at their sides and other workers had a tool in one hand and a weapon in the other. Yet the work of rebuilding the wall and restoring the many gates was finally brought to a most successful conclusion in record time. The secret of success is explained in one simple statement: "*the people had a mind to work.*" Moreover, there was a marvellous system of organisation and co-operation. The whole story makes one feel ashamed of the toluation in England's darkest hour of such treasonable tactics as the "ca' canny" policy, the limitation of output, and the exclusion from employment of the men who kept this country safe for those who stayed at home.

It is not now a question of rebuilding a city wall, but of reconstructing an entire continent—one might almost say a world. Yet where to-day shall we find men with the spirit of Nehemiah to say to those who would divert their attention from their colossal task: "I am doing a great work so that I cannot come down; why should the work cease whilst I leave it and come down to you?" And yet for want of such men reconstruction may share the fate of the Tower of Babel.

This is perhaps partly the fault of our system of education. For centuries we have been teaching our children that work is a curse—a punishment inflicted on the entire human race because of one man's sin; when we *should* have taught them that, like the other so-called curse—suffering—it is a means of salvation and redemption. As Emerson tells us: "A man's task is his life-preserver."

We also teach them to repeat glibly: "The whole is greater than its part," without showing them the spiritual meaning of this somewhat obvious statement, or its corollary—that the most infinitesimal part is essential to the completeness of the whole, or, as Kipling puts it, "The game is more than the player of the game, and the ship is more than the crew."

What we want is education for *Life*—not merely education for examinations. For this we must begin at the beginning—with the baby in the nursery school. Let us teach the child before his imagination is crushed out of him that there *is* a glory about his day's work, that it matters, and matters greatly, not only to the worker himself, but to his country and his God.

We must also get rid of the idea that there is only a glory about skilled or artistic work, and none about physical or mental drudgery. A man cannot become a skilled craftsman or an artist without serving a certain apprenticeship of drudgery. The world is learning slowly and painfully the lesson that each nation should perform its own drudgery, that it is a grave mistake to employ slave labour or foreign labour for this purpose. We are also gradually learning that it is a reproach rather than a distinction to belong to the "leisured classes." As the absolute necessity for increased production becomes more and more apparent, it is being brought home to all that, if England is to be saved from financial and national ruin, she can no longer afford to maintain idlers in her midst. Every man and every woman should have hours of work and hours of leisure. Alfred the Great was not so very far wrong when he divided the 24 hours' day into three parts—eights hours for work, eight hours for recreation, and eight hours for sleep; in other words, eight hours for useful work and 16 hours for recuperation. It is impossible to lay down general rules for the employment of leisure hours, as this depends on the kind of energy expended during the working hours; but part of the time should be devoted to the development of those faculties, talents, or powers that lie dormant during the performance of the daily round.

It has been said that labour leaders are the only politicians with vision and high ideals. But recent events and utterances seem to show that the vision is somewhat limited, and the ideals not so very high after all. The aims of Labour since the war have not reached any higher than the financial betterment of the working classes without regard to the prosperity of the industries to which they belong—the prosperity of their country so grievously afflicted by the Great War. They talk of "bringing the capitalist edifice crashing to the ground." Perhaps they do not remember the fate of Samson who brought a certain other edifice crashing to the ground. They are fond of saying that Capital is useless without Labour. May one be allowed to point out that Labour is also useless without brains to direct it and capital to finance it? In fact, Reconstruction in every direction is being hampered instead of helped by Labour. With regard to the housing difficulty the *Daily Telegraph* tells us:—

"The building trades are very much under-manned. Their numbers are less by 200,000 . . . . than they were before the war. Yet double that number of ex-Service men are unemployed at the present time, who would be very glad to join these and similar unions if admittance were not denied them. The whole country is crying out for houses . . . and yet, though tens of thousands of men are earnestly seeking work, they are shut out from the most obvious and most under-staffed field. The situation is aggravated by the decreased out-

put of the men actually at work, and thus a situation is created which is preposterous in the circumstances and utterly incapable of defence."

There seems only one way of ending the present lamentable deadlock, and that is to make all concerned in any way in any industry realise that "a house divided against itself cannot stand," that they are members one of another—fellow-workers each doing his part in a great work, and fellow countrymen each contributing to the prosperity of his country. As long as the antagonism between Capital and Labour lasts we cannot hope to draw any nearer to the promised New Earth. "Hatred will never cease by hatred."

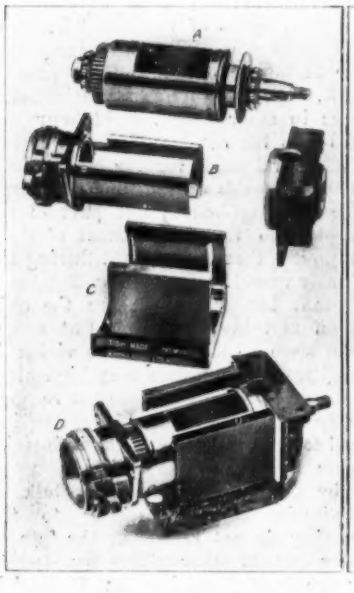
A just and at the same time practicable system of profit-sharing would, no doubt, do much to dispel the mists that at present obscure "the glory of the day's work." It has not yet been sufficiently recognised that profits are produced by the conjunction of money, brains and labour, and that any one of these factors is useless without the other two. But a greater incentive even than personal gain would be a change of heart, a change of attitude towards work, a re-kindling of that enthusiasm without which nothing great can be done.

A BRITISH MAGNETO WITH MANY DISTINCTIVE FEATURES.

By F. H. HUTTON.

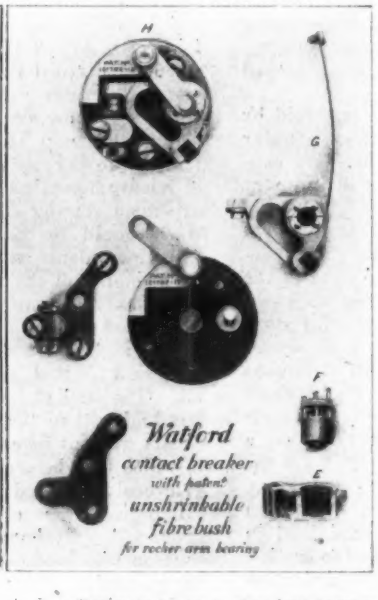
In these times it is pleasing to come across an industry which is in a thoroughly healthy state, producing machines of the very highest quality which embody many improvements over pre-war practice, and turning them out in satisfactory numbers to meet the enormous demand. A recent visit to the magneto works of Messrs. R. B. North & Sons, at Watford, showed all the foregoing remarks to be true in this instance. Being one of the firms who were up to the neck in magneto work all through the war, straining every nerve to produce machines for the arduous service then required, they can well claim that their present magnetos have come through an ordeal of fire in every sense.

A visit to these works is a real treat to anyone interested in fine engineering; the rows of beautiful little precision lathes, milling machines and grinders, the wonderful miniature automatics, &c., are an exhibition in themselves, while the foundry, a spot generally resembling a near approach to the lower regions, in this case is an apartment which might well be used as a dining hall! Such conditions, although they may not affect the design of the product, are generally to be found reflected in the class of workmanship turned out. Although a great deal might be said on this score, and on the extraordinary accuracy in the gauging of parts all through the works, it is time to proceed to details of the article manufactured—the new Watford magneto, of which the most noteworthy parts are shown in the illustrations. Briefly, the two main objects aimed at are to make the spark equally efficient throughout the whole timing range, and to improve the action of the contact-breaker by alterations in design. Dealing with the first point, we may remember that the worst fault of an ordinary magneto is that it produces its most effective spark only when the timing is set at one particular place. Since this place has to be arranged so that it suits normal running engine speeds (*i.e.*, high speeds) it follows that the correct positions for slow running and starting cannot be much used in practice. The reason is that a strong spark is only produced by the contact-breaker opening when the armature is in the most favourable position with regard to the magnets, in other words, when it is in the strongest magnetic field. These positions occur twice in a revolution, and are only momentary. The difference is made in the new Watford magneto by providing sliding pole-pieces or shoes for the magnet as shown in fig. 1, B and D. These extra pole-pieces, made of steel, are attached to the brass cam-ring, and project into the body of the magneto, fitting between the magnet itself and the armature. When the timing is altered by moving the cam-ring these extra pole-pieces move with it, the consequence being that when the contact-points open the magnetic conditions are always at their best. That is, whether the spark is timed early or late within the range provided, the spark is equal to that from an ordinary magneto at its maximum position. The idea of this improvement is admittedly not a new one, but in order to carry it out successfully the very highest class of workmanship is necessary, and to maintain this degree of accurate workmanship under the stress of ordinary commercial production is no easy task. This is the problem that Messrs. North & Sons claim to have solved. It will be realised that the sliding poles must be manufactured to the finest limits, and must maintain their position accurately under ordinary working conditions. In order to ensure this a small recess is cut in the end of the pole-shoes which engages with a spigot on the driving end-plate of the magneto, thus forming a guide and materially helping to keep the pole-shoes in place. The other parts illustrated in fig. 1 are the armature complete, the driving end-plate and the fixed pole-pieces.



A, Armature complete; B, Sliding pole shoes attached to cam ring; C, Magneto poles; D, Armature, magnet poles and sliding pole shoes assembled.

Fig. 1.—Magneto Parts.



E, Rocker (cut away to show bush housing); F, Unshrinkable fibre bush; G, Rocker with spring attached; H, Contact breaker assembled.

Fig. 2.—Contact Breaker.

The new contact-breaker, shown in fig. 2, is full of interesting features. The moving "arm" in this case consists of a triangular structure, very strong, but very light, being milled out of the solid with the greatest accuracy. The balance of this "arm" has been carefully studied with regard to neutralising the effects of centrifugal force at high speeds. An outstanding feature is the design of the fibre bush. Messrs. North & Sons are convinced that fibre is still the best material for this purpose, in spite of the alternatives which are available. They have therefore set about devising a bush made of this well-tried material which shall absolutely avoid the old trouble of swelling, and so causing the arm to bind. The result of their researches is seen in the illustrations E, F, and G, fig. 2. It will be noticed that the bush is larger than usual, that fine slits are made in certain places, and that a special

manner of fixing is employed. It is claimed that this bush has been tried to the utmost under the worst possible conditions, and that it is absolutely proof against swelling. A buffer is provided over the moving arm to restrain the flinging action at high speeds. Other details of this interesting contact-breaker are shown in the illustration, the complete view being at the top. This design of contact-breaker, being a further improvement on the pattern used so successfully on Watford magnetos in air service during the war, is well worth attention.

LEAVES FROM AN INSPECTOR'S NOTEBOOK

By "ANODE."

One of the most interesting things in an insurance inspector's life is the examination of breakdowns. To say nothing of the uncertainty of these, it is distinctly exhilarating after a hard day's work, probably underground, to arrive at home and find a wire awaiting you, informing you of a breakdown, probably not two miles from the place you have been at all day.

I remember on one occasion receiving a wire asking me to proceed to a town some hundred odd miles away, after a journey in the corridor of a train for three hours. I left home next morning in no very amiable spirit, and on arriving at the scene of the catastrophe I found it was nothing more than a break in the shunt windings of a 2-h.p. motor. As the break was between the field coils, it was remedied in a few minutes, and naturally it did not improve my peace of mind; still it might have been worse, and for small mercies we must be thankful. Not all breakdowns, however, are so simple. Once I was out making an inspection of a large plant some distance from a station and had to hire a conveyance, and could only hire the car for the day. I did the inspection, and decided to visit a colliery some miles away, and make a part inspection at any rate. The electrician was a personal friend, both of us having worked in the same shop, so the visit was likely to be a pleasant one. On inquiring at the power house for my friend, I was informed that he was underground, and had been there for the past 24 hours, having had trouble with a 250-h.p. motor, which was insured. Now this was very awkward, as spats and light boots are not exactly healthy underground; and this colliery prided itself on its own particular and exclusive brand of slush underneath. If I had my way I would make it a criminal offence to have any colliery underground; they all ought to be on the surface, and near an important station. But we cannot always get what we want, so I had to make the best of it. I then had an idea that probably the trouble was with the pump, and not the motor, in which case my worthy colleague, the mechanical inspector, would have the jubilee. I got hold of the electrician on the 'phone and asked for the news, devoutly hoping that it was the pump. This reminds me of the occasion when I visited a friend in a hospital early one morning. He was in a bad way, and no hope could be entertained of his recovery. The nurse hoped that he would last out till 8 o'clock, and she seemed quite concerned about it. On my inquiring why she was so anxious, she calmly told me that if he died before eight she would have to lay out the remains, but if he lasted till after eight, the day nurses would have the job. I felt something like the nurse, thinking of my beautiful spats. But my luck at this part of the proceedings was dead out; it was the motor, so I reluctantly descended, and ruined my pretty spats.

On entering the chamber of horrors I was told that the trouble was overheating of the rotor, and that everything possible and impossible had been done, even to the extent of fitting new bearings and altering the taps on the starter. Now I knew this particular breed of machine. I looked very carefully at the junction of the rotor bars and short-circuiting ring, and found that the joints were black; this proved to be the trouble—resistance in the rotor circuit. My friend was not by any means pleased at the diagnosis, especially at the difference between his 24 hours and my 24 minutes.

It is surprising what a little thing will cause trouble in a motor. I well remember on one occasion being asked to look at a small motor which was sparking badly. It was an old type of machine, and had run for seven years without any trouble till then, when it started eating a set of brushes up in a week or so. I tried altering the brush position, but without effect; tested the armature thoroughly, everything correct; when I noticed that there were no flexibles on the brushes. The attendant, a new man, told me that he did not see the use of them, so he cut them off. On fitting a new set with leads on, the trouble ceased. Sometimes it is very easy to be too particular, and on one occasion I got badly let down, and my company let in for £20. At a large restaurant there was a small single-phase motor used for driving an ice-cream freezer, and the starting device was the usual phase splitter, the handle of which was missing. I pointed this out on my reports for some considerable time, until I decided that it was time my recommendation was carried into effect, so I interviewed the proprietor, and pointed out the danger of the attendant putting his fingers inside the starter to get hold of the cross bar, mentioning that 210 volts at a frequency of 93 was not healthy, and that if he had a weak heart, or status lymphaticus, there would be a coroner's inquest, and he would not come off lightly. That "status lymphaticus" fetched him, and he promised that the necessary would be done instantly, immediately, forthwith, and personally. This was on a Thursday, and on the following Monday I received a wire asking me to attend at a breakdown at this establishment. On arrival I found the motor burnt to rags and cinders. The machine was left O.K. on the Saturday night, and it was found burnt out on the Monday morning, when they opened the premises. All that I could find was that the starter was discovered to be in the running position, but the attendant was positive that he left it in the off position. In addition to having to report the details of the breakdown, I had to give the cause of it, which was not easy in this particular instance. While I was thinking it over, a cat jumped up to a window, via the starter, and in doing so it fouled the new handle, and pushed it into the running position.

Q. E. D.

SINGLE-PHASE METERS ON BALANCED THREE-PHASE, THREE-WIRE SYSTEMS.

By H. G. SOLOMON.

The use of one single-phase meter to register the consumption in a three-phase, three-wire network is still largely prevalent when the system is regarded as balanced. The method is, however, almost invariably wrong, and in many instances leads to totally incorrect results, even though the load actually constitutes a balanced load in itself. It should be entirely discarded, as it is not difficult to prove that a single-phase meter will only correctly indicate the three-phase consumption on the fulfilment of two conditions—perfect balance and unity power factor—which never obtain together in practice. These two conditions must go hand-in-hand, as however well-balanced the system may be, if a power factor less than unity be present, considerable inaccuracy dependent upon the magnitude of the power factor will ensue, apart from the characteristic errors of the meter itself.

The only proper method of measuring the consumption is the employment either of two single-phase meters on the well-known two-wattmeter connection, as indicated in the accompanying diagram, or of a three-phase, three-wire meter. The latter is simply a combination of two single-phase meter elements to form a single instrument, with one counter which registers the total consumption, and is connected in exactly the same manner as when two separate single-phase meters are employed. In the

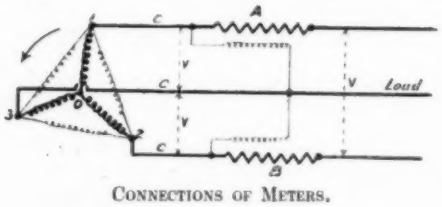
latter case the consumption is the algebraic sum of the two meter readings.

Referring to the diagram, if the phase voltages pass through their maxima in the sequence of 1, 2, and 3, then meter A will be in the leading phase, and meter B will be in the lagging phase. Since the system is supposed to be balanced, the voltages between any two of the mains will be equal to one another, and the currents in the mains will be the same. Representing the voltage and the current by V and C, as given by a voltmeter and ammeter respectively, and denoting the power factor by cos ϕ, then the mean power is—

$$P = VC\cos(\phi - 30^\circ) + VC\cos(\phi + 30^\circ) = \sqrt{3}\,VC\cos\phi.$$

Regarding the power as remaining constant over a given interval of, say, one hour, then the energy consumption in watt-hours will be represented by the same equation. The one meter A in the leading phase will read $VC\cos(\phi - 30^\circ)$, the other meter B in the lagging phase will indicate $VC\cos(\phi + 30^\circ)$, and the total consumption will be their sum, namely, $\sqrt{3}\,VC\cos\phi$.

A. Unity Power Factor.—When there is no displacement between the phase voltages and the currents, *i.e.*, when the power factor is unity, $\cos\phi = 1$ and $\phi = 0$. A will thus give $VC\cos 30^\circ$, *i.e.*, $\frac{1}{2}\sqrt{3}\,VC$, B will indicate the same amount, and their sum is $\sqrt{3}\,VC$, the total consumption. It will be observed that in this case each meter, independently of whether it is in a leading or lagging phase, will register one-half of the total energy. Consequently, if one be employed, say A, connected in any one of the three-phase mains as a two-wire meter, and its dial reading be multiplied by 2, it will correctly give the total three-phase energy, but in this case only. When a single-phase meter is used in this manner, the dial reading, in general, gives



CONNECTIONS OF METERS.

the total amount directly, without the use of the multiplier 2, as this is taken into account in the gearing between the integrating train and the rotor spindle.

B. Power Factor less than Unity.—In this case the total energy is still $\sqrt{3}\,VC\cos\phi$, and the two meters read as before $VC\cos(\phi - 30^\circ)$ and $VC\cos(\phi + 30^\circ)$.

Suppose the load consists of a three-phase motor running at full load with a power factor of 86·6 per cent. for the given interval of one hour. Then $\cos\phi = 86{\cdot}6$ per cent., and $\phi = 30^\circ$. The three-phase energy absorbed by the motor is $\sqrt{3}\,VC\cos 30^\circ$. Meter A shows $VC\cos(30^\circ - 30^\circ) = VC$; meter B indicates $VC\cos 60^\circ = \frac{1}{2}VC$. Their sum equals 3 vc/2 which is $\sqrt{3}\,VC\,\sqrt{3}/2 = \sqrt{3}\,VC\cos 30^\circ$, the total energy.

Although the load is a really balanced one, meter B, it will be seen, registers $33\frac{1}{3}$ per cent., and meter A $66\frac{2}{3}$ per cent. of the total consumption, which is simply their sum. There is, of course, nothing astonishing about this. It is merely a reiteration in different terms of the preceding statement, and is made in this way to emphasise the fact, which does not appear always to be fully realised, that, despite the balance of the system, when a power factor less than unity exists it is quite impossible from the three-phase principle for the meter readings to be equal. Their inequality does not point to a want of balance, but to an inductive load. If, therefore, the single-phase meter for three-phase balanced loads be used, for example, in the leading phase, such as A, it will read $2 \times VC\cos(\phi - 30^\circ)$, and since $\phi = 30^\circ$, its indication will be $2 \times VC$. The true amount is $\sqrt{3}\,VC\cos 30^\circ$, which is the same as $\frac{3}{2}VC$. Hence the single-phase meter when in the leading phase will be *over-registering* by $33\frac{1}{3}$ per cent. of the true amount. If connected, on the other hand, in the lagging phase as B, it can be shown in a similar manner that it will be *under-registering* to the same extent.

Next, suppose that the motor is running light, when its power factor may be of the order of 50 per cent., *i.e.*, $\cos\phi = {\cdot}5$, which means that $\phi = 60^\circ$. The true load is $\sqrt{3}\,VC\cos\phi$, or $\frac{1}{2}\sqrt{3}\,VC$ (C is now different in value from the full-load current). Meter A correctly gives $VC\cos(60^\circ - 30^\circ) = VC\,\sqrt{3}/2$, which is the total energy, and meter B gives no reading at all, as it has stopped ($VC\cos(60^\circ + 30^\circ) = 0$). Hence the single-phase meter for three-phase balanced loads in the leading phase will give $2 \times VC\cos 30^\circ$, *i.e.*, $\sqrt{3}\,VC$, which is twice the true total energy, and will thus indicate 100 per cent. high. Of course, in the lagging phase the meter will stop and not give any reading, whereas the actual total consumption is still $\frac{1}{2}\sqrt{3}\,VC$.

Even with so high a power factor as 97 per cent., which is rarely exceeded with purely lighting loads, the errors are not so negligible as they are commonly supposed to be. With this power factor the corresponding angle of lag is 14°, the true total energy is 1·68 VC, whereas, as is easily shown in the same way as in the other examples, the one single-phase meter for polyphase loads will have an error of + or — 14·3 per cent. of the total amount according as it is in a leading or lagging phase.

THE PROGRESS OF THE SPANISH ELECTRICAL INDUSTRY IN 1919-20.

IN reviewing the progress of the Spanish electrical industry in 1919-20, the *Energia Electrica* places in the forefront the "transformation into Spanish of a great German electric undertaking," as it terms it, namely the Deutsch-Ueberseeische Elektricitäts Gesellschaft, under the style of the Sociedad Transatlántica Alemana de Electricidad. The transformation is due, it appears, to the exertions of the late Minister of Patronage, Don Francisco Cambó, to whom are owing other important financial and industrial innovations. The present financial situation in Germany and the enormous depreciation of the mark have forced the German company, in order to obtain capital for extensions and acquisitions of raw materials, to consider either a sale of the assets or the transformation of the company. The English and the Americans, according to the Spanish paper, contended together in offers for the many light and power concessions of the German company in the numerous cities of South America; but the outcome arrived at is owing to the exertions of Señor Cambó, and "the sympathy shown for Germany by Spain during the war." The headquarters of the new company will be in Madrid and its technical offices in Barcelona. Its capital will be 300,000,000 pesetas, a portion of which will be taken up by a Spanish group of bankers.

Besides the important event above chronicled, other noteworthy occurrences show plainly that, far from interruption of the rapid unfolding of the Spanish industry initiated some twelve years ago, that industry has continued to develop with ever-increasing speed. Passing by the 200,000,000 pesetas invested in electric installations now completed, new companies with strong capitals have been formed in the past year, to carry out already planned schemes which, it is to be hoped, will rapidly pass into the state of tangible realisation.

The Sociedad Electrica de Lima, which during 1919 raised its capital from 4,000,000 to 10,000,000 pesetas, has finished the erection of machinery for the first hydroelectric group of 8,750 KW., and has founded an offshoot, the Union Electrica Portuguesa, which, like the company of the same name in Madrid, is engaged in distributing current in Oporto, Braga, and other localities in the neighbouring country, the current being drawn from the falls of Lindoso, 12 kilometres from the frontier; it has both carried out the erection of the transmission lines to Oporto (80 km.) and completed the transformer station in that city. A Portuguese group subscribed 50 per cent. of the capital of the Union Electrica Portuguesa, the balance being put up by Spanish offshoots of the Hidro-electrica Iberica y Española, owning the Lima falls whose capacity is 20,000 H.P.

The Sociedad Hidroelectrica Iberica is continuing its works at the Cinca falls (Huesca), and to obtain further resources and to develop the Cinqueta falls (47,000 KW. from the two falls), besides the 20,000,000 pesetas of bonds raised in 1918, decided last month to increase its capital by 20,000,000 pesetas, bringing its total capital up to 60,000,000 pesetas.

The Hidroelectrica Española, prosecuting its development of the Dos Aguas falls, for which it has ordered two 23,000-H.P. Escher Wyss turbines, hopes by the end of the year to have working 20,000 H.P. of the 100,000 available.

The Sociedad Productora de Fuerzas Mortices issued in 1919 4,000 500-pesetas bonds in order to install a third electrogene

group at its falls, already completed, of 20,000 H.P. capacity on the river Flamisell (Lerida); the greater part of its output (16,000 H.P.) is supplied to the Energia Electrica de Cataluña. This important company, whose capital is over 100,000,000 pesetas, finished in 1919 the installation at its Molino falls on the River Flamisell, its 20,000 H.P., with 40,000 H.P. from the Capdella station on the Flamisell, being supplied to Barcelona, Sabadell, Manresa, Granollers, Cornella, Badalona, Gerona, Palamos, Palafrugell and other localities in Cataluña.

The Cataluña de Gas y Electricidad, which is the oldest company supplying energy to Barcelona (having been constituted in 1843) and has a capital of 60,000,000 pesetas, continued its works at the falls of Puente Argone, on the River Esera, in 1919, where it has just started a Piccard-Pictet-Oerlikon 5,000-H.P. hydroelectric group. As this company harnessed in 1918 the Run fall, of 36,000 H.P., in three 12,000-H.P. units (the hydraulic installations and central being planned for four units, which with two groups of exciters, total 50,000 H.P. at the shafts of the turbines), it has disposable this year 41,000 H.P., which is absorbed by Barcelona and its industrial belt.

The huge Sociedad Fuerzas y Riegos del Ebro, which already disposes of 100,000 hydroelectric horse-power, has continued to prosecute its operations at the Camarasa fall at Noguera Pallaresa, without, however, installing the two groups yielding 36,000 H.P., which it expects to obtain from this installation. Similarly it has continued its operations at Electra del Viesgo on the Torina, capable of producing 10,000 to 12,000 H.P., and at the Camarmena fall (12,000 H.P.) on the river Cases, for which the machinery was ordered some months since in Switzerland. The Sindicato de Saltos de Agua del Cantabrico has continued its hydraulic operations at the group of three falls at Saja (15,000 H.P.) and bought the turbines for the equipment of an auxiliary fall of 200 H.P. to assist the works.

The Hidroelectrica de Navarra has inaugurated its works, built in the Laguna del Duque, where 1,000 H.P. is obtained from a 215-metre fall, supplying 60,000 volts to Salamanca and Penaranda; this power is capable of being raised to 6,000 H.P. by means of works already projected on the Laguna and at Trampal.

The Energia e Industrias Aragonesas Company, with a capital of 10,000,000 pesetas (formerly the Compañia Catalana de Productos Quimicos), began this year the building of a station at Biescas, and proposes to develop six falls, estimated to yield 50,000 H.P., at localities on the rivers Gallego and Ara.

The greater consumption of energy which has become noticeable in all centres of population and industry of any importance has forced electric undertakings to increase their means of hydroelectric production. Among those which have carried out works with this object may be cited the Union Electrica Madrileña, which formed last January the Electrica de Castilla, with a capital of 7,500,000 pesetas, which concern has begun works at El Jucar falls to yield 15,000 H.P., whose plant will be linked up, by a 100,000-volt transmission line, to the Falls of Bolarque which supply Madrid.

The Hidraulica del Cantabrico, 15,000,000 pesetas capital, has likewise undertaken construction, at its second fall, in order to increase to 12,000 H.P. the 6,000 H.P. now obtained at Gijon and Oviedo, at the same time acquiring the Candas fall, lines, power station, and distribution network of the Electra Asturiana.

The Sociedad Anonima Mengemor, which obtains 6,300 H.P. from its five falls on the rivers Ohanes, Quadelimar and Guadalquivir, issued in January last bonds for 7,500,000 pesetas to continue the works at its El Carpio fall, to yield 7,000 H.P., which will be absorbed in the provinces of Cordoba and Jaen.

The Compania Sevillana de Electricidad is developing the fall of Las Buitreras, affording 5,000 H.P. at Cortes de la Frontera (Malaga) to supply the Andalusian capital.

The Sociedad Electricas Reunidas de Saragoza has begun the operations of development of a 6,000-H.P. fall on the Gallego river.

Lastly, the Electro Industrial Coruñesa, owner of the Capela fall on the River Eume, is increasing its hydroelectric installations in presence of the growing calls of its clients in La Coruna and El Ferrol, where the lack of electric current, as also in Vigo, is principally owing to the great impulse given to maritime constructions. More than the 11,000 H.P. to be supplied by the works on the River Tambre now under construction will certainly be required by the Electra Popular de Vigo y Redondela to meet the demands of its customers.

Among the various concessions of water rights are worthy of mention (apart from the 300,000-H.P. scheme of the Sociedad Hispanoportuguesa) that recently secured by the Electra de Viesgo, of 55,000 H.P. on the River Sil. Its objective is mainly the development of mining operations in these regions. For this purpose it has further acquired the assets of the Energia Electrica de Asturias, with its Casomera fall yielding 2,000 H.P., and intends to acquire others.

Passing to electric traction, it may be mentioned that last year was opened to the public the first section (four kilometres) of the north to south line of the Madrid Metropolitan; following which are those of Barcelona and Bilbao, already under construction. There has been inaugurated the last section (Rubi to Tarrasa—9,242 metres) of the Barcelona to Tarrasa railway, which makes a total of 29.6 kilometres. Electricity has replaced animal traction on the Irun to Fuenterrabia tramway. Service has begun on the Vigo to Porrino tramway, the first section of the Vigo to Mondariz line, and a junction has been made at Pinos Puente with the Granada suburban system, owned by the Tranvias Electricos de Granada, which has an extent of 45 kilometres.

What has been said above justifies fully the statement, says the *Energia Electrica*, that the past year has seen a remarkable spurt in the Spanish electrical industry, the most noticeable feature of which has been the absorption of large capitals and the amalgamation of companies. No one can doubt that power is produced much more economically from the large hydraulic works than from the medium-sized or the small, hence these enlargements are more advantageous for the industry and the country.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Earthing Clip.

An ingenious and effective earthing clip has been brought out by the METALLIC ELECTRICAL ENGINEERING CO., LTD., of 153, Corporation Street, Birmingham. It is shown in the figure, which explains itself. The clip is made of brass, and

FIG. 1.—"METALLIC" EARTHING CLIP.

a sample before us shows that there is plenty of metal in it. No soldering is necessary, and the earth lead is firmly held. Five sizes are made, to fit tubes from ⅜ to 1 in.

A New Switch.

An ingenious tele-switch intended to replace the ordinary two-way switch, and to enable lamps to be controlled by means of pushes and bell wire, has been introduced by Messrs. I. CALVETTE, LTD., 11, Little St. Andrew Street, St. Martin's Lane, London, W.C.2. The switch itself is shown in fig. 2, and a diagram of connections indicating the general principle in fig. 3. It will be perceived that the tele-switch which controls the lamp or lamps is composed of a vertical electro-

FIG. 2.—CALVETTE TELE-SWITCH.

magnet with the poles extended horizontally, with a movable armature A pivoted to the lower pole. The electro-magnet is energised by means of a single dry cell, and the circuit is completed by push buttons, which can be fixed in any number of positions. If, for instance, the armature of the tele-switch

is in the left-hand position as shown in fig. 2, and one of the buttons is pressed, the armature will take up the vertical position between the poles, and the small catch to be seen near the top of the armature will fit into the slot just beneath it, but when the push button is released, the armature falls to the right and closes the spring contacts seen in fig. 2, causing the lamp to be switched on. On again pressing the same button, or one of the other buttons, the armature is again acted upon by the electro-magnet and moved into line with the poles, thus opening the contacts, and when the press button is released, the armature falls to the left. Thus lamps can be controlled at any point where the press buttons are fixed, and bell wiring can be used instead of the more expensive electric light wiring enclosed in tubing or casing. Any number of pushes can, of course, be used, and the tele-switch can control a number of lamps, a fan, motor, or any other electrically operated apparatus, the only variation in the design necessary being that when heavy currents have to be dealt with mercury contacts B are used instead of the spring contacts illustrated. With a separate tele-switch connected in each pole of the main supply circuit it is possible to extinguish the whole of the lamps in a building simply by pressing a button. For hotel lighting this tele-switch is particularly useful, for pushes can be fixed outside doors in passages, in rooms, or pear-shaped pushes can be suspended near beds. All the lamps on staircases can be controlled by a push button at the street door, and if desired by similar pushes on each landing. There are many possible applications of the switch. When it is used in conjunction with a clock movement and battery circuit, electric signs can be controlled in various ways, and the switch can also be employed with advantage for controlling stage lighting. The tele-switch can, of course, readily be applied to existing installations. There is nothing that is liable to get out of order, and as low voltage bell wiring is used for the control circuits, the erection of the wiring is greatly facilitated and extreme neatness easily secured.

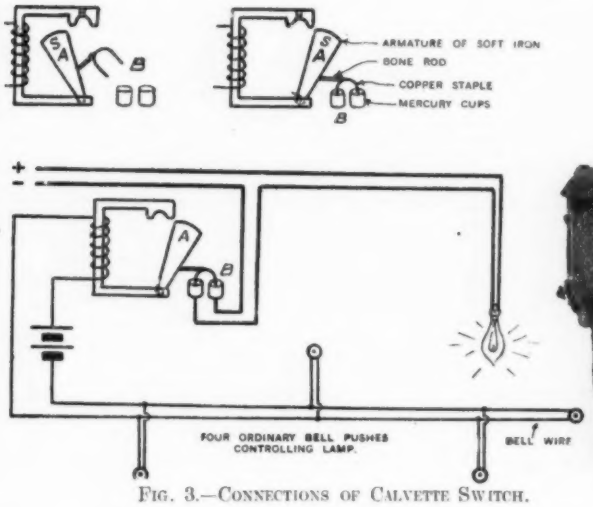


FIG. 3.—CONNECTIONS OF CALVETTE SWITCH.

Melbourne Railway Signalling Gear.

A new form of switchgear, specially designed for signalling circuits, is shown in the accompanying illustrations, figs. 4 and 5. This, in itself, is a complete small power-station switchboard, consisting of two generator and two outgoing feeder panels. The switches are for 30 amperes, 2,000 volts. The busbars also are completely enclosed, and are run in solid with compound. For synchronising purposes potential transformers are required with each panel, and these, as shown in the figures, are carried at the back of the busbars, where they are plugged in a similar way to the switches. Fig. 4 shows one potential transformer in position with the tank on, and another with the carriage drawn out and the tank lowered. It is claimed that the interlocking features of this gear are very perfect. It is impossible, without interference with the mechanism, to lower the tanks to get access to the conductors until the switches are drawn out and therefore safe to handle. Moreover, the switch or potential transformer may not be plugged in until the tank is reinstated in its correct position, thus ensuring great safety to the operators. The diagram, fig. 6, shows the connections of two panels, which form part of one of three inter-connecting boards. The apparatus was made by MESSRS. A. REYROLLE & CO., LTD., of Hebburn-on-Tyne.

G.E.C. Oil-break Switch.

Among the appliances illustrated in a recently published catalogue listing high tension switchgear manufactured by the GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C.4, is an oil-break switch with an ammeter attachment for mounting on a wall. This switch is suitable for three-phase circuits, and is fitted with two overload releases and time lags. The maximum current the apparatus will carry is 60 amps., and the overload trip coils can be wound for normal currents of 10, 30, and 60 amps. Fig. 7 shows the complete switch and attachment, and fig. 8 illustrates details, the tank and cover being removed.

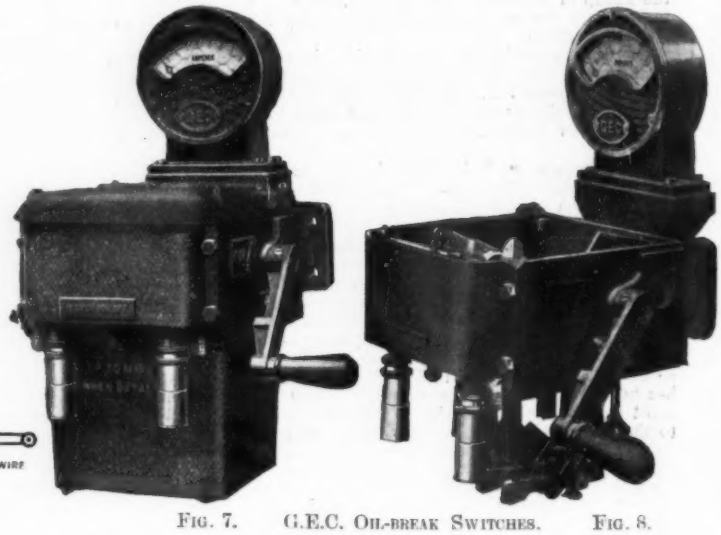
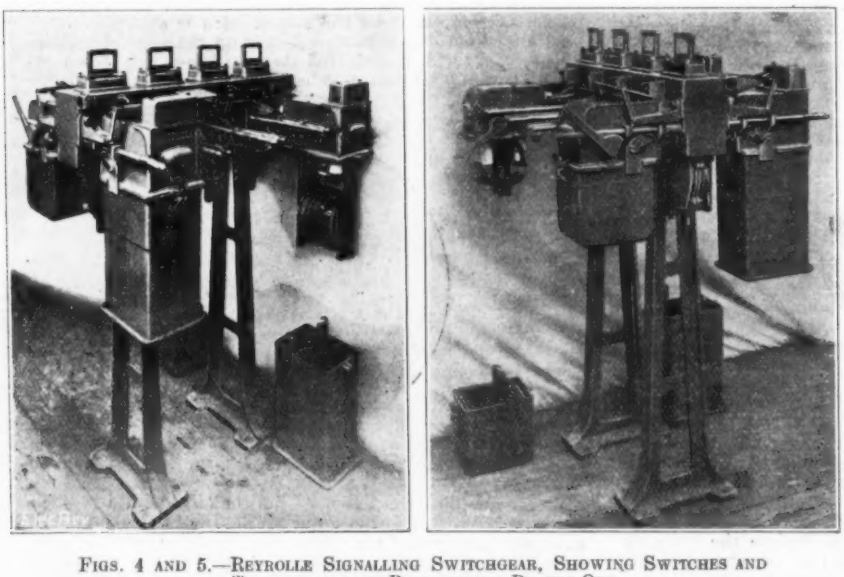


FIG. 7. G.E.C. OIL-BREAK SWITCHES. FIG. 8.



FIGS. 4 AND 5.—REYROLLE SIGNALLING SWITCHGEAR, SHOWING SWITCHES AND TRANSFORMERS IN POSITION AND DRAWN OUT.

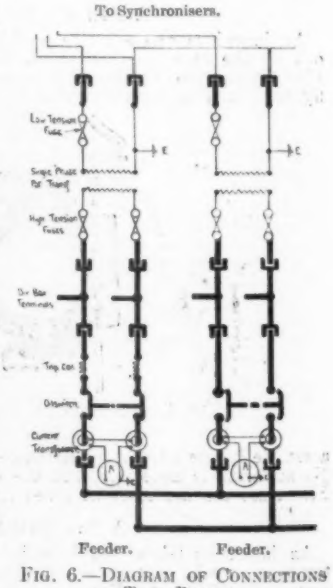


FIG. 6.—DIAGRAM OF CONNECTIONS OF TWO PANELS.

LEGAL.

British Thomson-Houston Co. and Duram Litigation.

In the Chancery Division on Friday Mr. Justice Astbury heard a summons taken out by the plaintiffs in this action. Plaintiffs in their action allege infringement of their patent for the manufacture of tungsten filaments for electric lamps. The validity of the patent is denied by the defendants, and the infringement is put in issue. The summons of the plaintiffs was that they might be at liberty by their general managers, solicitors, and scientific witnesses to enter the premises and works of the defendants at Hanwell and to inspect work, and examine the process used by the defendants for the manufacture of their drawn tungsten wire. Defendants opposed inspection, and set up a secret process.

Sir A. Colefax, K.C., Mr. J. Hunter Gray, K.C., and Mr. Trevor Watson appeared for the plaintiffs; and Mr. T. Terrell, K.C., Mr. Kerby, K.C., and Mr. Courtney Terrell for the defendants.

His Lordship, in deciding the question raised by the summons, said the circumstances under which inspection ought to be ordered in this case and the safeguards which ought to be imposed required to be most carefully considered. Defendants set up a secret process, and it was obvious that there was a difficulty where a secret process was set up in infringement actions of this character to devise a course which would do real and substantial justice to both parties without doing a grave injustice to either. He was not prepared to accept entirely the view expressed in the expert evidence submitted. The specification of plaintiffs' patent was a long and intricate one, and apparently was for an improvement in certain earlier processes in patents of 1906 and 1907, and there were five claims. He had suggested that before deciding whether inspection was or was not necessary the defendants should answer candidly and plainly a series of interrogatories to be delivered by the plaintiffs, with the object of asking defendants as to each step which in their judgment was indicated and protected by their own letters patent. This defendants had offered to accept, and they had also offered to give a full admission that they produced their tungsten rods under heat, and that the rod was drawn down by successive stages to the finest wire. Plaintiffs were desirous, however, of having an inspection at once, but having regard to the defendants' expressed willingness to answer questions which the plaintiffs would be permitted to frame as they were advised, he proposed to allow the summons to stand over until after he had seen the answers which the defendants were willing to make to the plaintiffs' questions.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Wiring Small Houses.

In the Electrical Review of May 7th there is an interesting letter from Mr. Inch on the wiring of small houses, dealing with the American method, in which no tees or elbows are used, the tubing being looped from point to point.

It would be very interesting if Mr. Inch would give further details of this method of wiring, particularly as many small houses are now being wired.

Installation.

June 1st, 1920.

"Situations Vacant."

I have just one little quota to add to the testimony of those who decry the use of box numbers by advertisers of vacant situations.

Recently I applied for a vacancy advertised under a Box No. in your journal. Being one of the very humble fry in this most excellent of all professions (or callings), I am in the habit of receiving many dismal reminders of my insignificance; especially subject am I and are mine to the snubs of those who by fortunate circumstance have climbed from among us. But there was one thing we would not stand, and that was a starvation wage, so we became members of a trade union, and thereby increased our remuneration doublefold, as well as established a fixed schedule of wages for our class of employment.

There are many economically minded chiefs who have very narrow views of what is adequate remuneration for their staffs, and who do not scorn the use of any method which will allow them to escape their obligations.

In reply to my application, I received a request to attend for an interview. This I did. At the interview I was offered a wage about 17s. 6d. per week less than the standard schedule rate, under the specious plea that the appointment was probationary—probationary for an undefined period.

I submit that the Box No. was used as a deliberate cloak to hide the identity of the advertiser in order that this individual might perpetrate his meanness undiscovered. To suggest a probationary period at less than standard wages to skilled, trained men of over 20 years' experience, is something which would not be done by the engineer and manager of a London municipal undertaking in an open public advertisement.

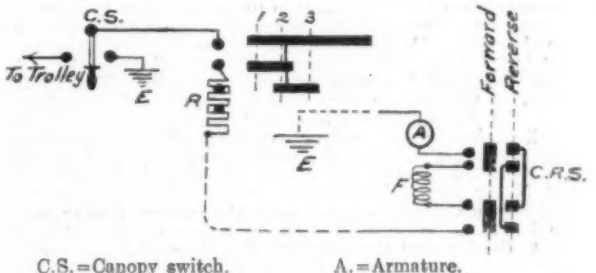
F. N. K.

June 7th, 1920.

Emergency Braking.

In your issue of the 21st May Mr. C. E. Slack asks if anyone can suggest a simple method of using regenerative control for emergency braking, with one motor defective and cut out of circuit. I cannot think of any means to this end without some addition to the wiring, and herewith offer the simplest method which has occurred to me. Either a two-way canopy switch or an additional one-way switch would be required; if the latter, it would preferably be interlocked with the canopy switch, so that both cannot be closed together.

The following sketch will probably explain my idea:—



C.S. = Canopy switch. A. = Armature.
R. = Grid resistance. F. = Series field.
C.R.S. = Controller reversing switch.

To obtain braking effect:—

1. Throw C.S. across to other contact. "Notching" arm of controller, of course, must be at "zero" position.
2. Pull reversing handle back.
3. Move "notching" arm carefully up on the *series* notches; the last notch will not be reached, as some resistance will always be required in circuit, at least until the speed has dropped to a low value.

I have not shown all of the main drum of the controller, but instead have dotted the leads to denote that other switches and apparatus lie between the canopy switch and the reverser, and also between the armature and ground.

As no alterations are required on the controller wiring or contacts, &c., this will not confuse anybody.

W. G. Stuart.

Trethomas, *May 26th*, 1920.

An A.E.G. Turbo-Alternator.

May I be allowed the hospitality of your columns to bring to the notice of those interested in the electricity industry the proposal of the electrical engineer for the Newport (Mon.) Corporation Electricity Department to place the order for repair to, and a new rotor for, the A.E.G. turbo-alternator installed at the power station with the A.E.G. of Berlin?

It would be interesting to know if our own manufacturers have been asked to quote for this work.

It may be that there are special features connected with this machine which make it essential to have the "Jerrys" on the job.

If such be the case, the quicker this machine is put out of commission the better, and replaced with one of British manufacture, made and capable of being repaired, if necessary, by British labour.

Buffish.

The London Hospital.

Probably many of your readers have seen my recent letter in the *Times*. The London Hospital—the biggest in England and in London's most crowded corner—is on the rocks.

A few days ago we could not pay our week's bills, and we are still faced with the tragedy of closing.

The week's bills require £4,000, and I am thankful to say I have received two cheques for that amount from two gentlemen in the City—who prefer to remain unknown—each undertaking the upkeep for one week.

This way seems to lie salvation.

May I appeal to anyone whose business is flourishing to keep the whole hospital for a week? Failing that for a day or an hour—not a difficult calculation!

Kuntsford,
Chairman.

Whitechapel.
June 5th, 1920.

E

ELECTROLYTIC CAUSTIC SODA-CHLORINE CELLS.*

The principle of the electrolysis of brine for the production of caustic soda and chlorine is exceedingly simple. On the passage of a current of electricity through a solution of common salt chlorine gas is evolved at the anode, or remains dissolved in the liquid surrounding it, while at the cathode hydrogen is liberated and caustic soda is formed. Owing, however, to the secondary reactions which ensue the primary products of electrolysis are not available in a simple cell to the extent theoretically possible. In consequence numerous modifications have been introduced with the object of eliminating or controlling these secondary reactions.

If it were possible to remove the chlorine, caustic soda, and hydrogen as rapidly as they were formed, no current would be used in the secondary reactions, and the ampere-hour efficiency would be 100 per cent. In other words, each ampere-hour would yield 1.3220 gm. of chlorine, 1.4910 gm. of caustic soda, and 0.03759 gm. of hydrogen. In actual practice the ampere-hour efficiency ranges from 90 to 98 per cent.

The energy efficiency depends upon both the current and the voltage of the cell. The cell voltage comprises two parts, the voltage required to decompose the solution and the voltage necessary to overcome the resistance of the solution and of the electrodes. The decomposition voltage of brine is approximately 2.3 volts, and no current will pass through the cell until the applied voltage exceeds this value. The usual operating voltages are from 3 to 7 volts per cell dependent upon the design, temperature, and current density. With a cell having 100 per cent. ampere-hour efficiency operating at a pressure of 2.3 volts the energy efficiency would be 100 per cent. In practice the energy efficiency is between 30 and 75 per cent. The difference in the voltage of different cells depends almost entirely upon the current density and the length of the current path in the electrolyte. This is due to the fact that the resistivity of a 25 per cent., or nearly saturated, brine solution is 1.76 ohms per inch, or 2½ million times that of pure copper. Consequently a great area of electrolyte and a short current path are required to avoid an excessive voltage drop.

Of the electrolytic chlorine cells in commercial operation the *diaphragm* type is the most satisfactory at present on the market. In this type a porous partition, usually consisting of a moulded asbestos compound, separates the anode and cathode compartments, and the flow of the electrolyte itself is made to oppose the passage of the caustic soda to the anode compartment. The gases, chlorine and hydrogen, accumulate above the surface of the electrolyte and are readily drawn off. The caustic soda is removed from the cathode partially by the flowing salt solution and partially by gravity.

The earliest successful diaphragm cell was the Griesheim, first used in Germany in 1890. In this cell an iron container serves as the cathode. The anodes are plates of magnetic iron oxide, and the diaphragms formed of a composition of salt, cement and hydrochloric acid compose the walls of the box-shaped anode compartments. In use the salt dissolves and leaves a very fine porous wall. These cells are steam-jacketed, and the temperature of the electrode is kept between 80 deg. C. and 90 deg. C. The anode current density is from 10 to 20 amperes per square foot.

Of the diaphragm cells in use may be mentioned the Hargreaves-Bird in England; the Finlay in Belfast; the Gutheniu-Chalandre extensively employed in France, Switzerland, and Spain; the Billeter-Leykam in Austria; the Townsend, Le Sueur's, Billeter-Siemens, Allen-Moore, Wheeler, Jewel, and Nelson in the United States of America.

The largest single chlorine plant in the world is the U.S.A. Government plant at Edgewood Arsenal, Baltimore, where over 3,500 Nelson cells are installed for the production of 100 tons of chlorine gas per 24 hours. This plant was installed during the war in four months. In fig. 1 is given an illustration of the Nelson cell embodying the latest improvements. The body of the cell consists of a rectangular tank of ¼ in. steel plate in which a U-shaped cathode of perforated sheet steel is mounted, and acts as the form for the anode compartment. The cathode supports the asbestos diaphragm, and the U-shaped anode compartment is closed at the ends by blocks of cement mortar. The top of the anode compartment is closed by an inverted rectangular box of slate slabs which support the graphite blocks that form the anode proper. The anode blocks are 4 in. by 4 in. by 17 in., and the lugs are 2½ in. in diameter by 12 in. long. They are specially treated, with a consequent increase in their life of more than two years, and they have but one joint, which ensures maximum conductance. The cells are fitted with an automatic feeding device which is simple and has proved reliable in service. It consists of a float on which is mounted a dull knife edge which presses against a piece of rubber tubing through which the brine is supplied to the cell. The slightest rise of the float cuts off the feed entirely, and the smallest drop permits the flow to start again. No trouble is caused by dirt in the brine, as it is purified before passing into the cells, it being essential in the operation of a chlorine cell for iron, alumina, lime, and magnesia to be excluded. The rate of percolation of the brine through the diaphragm is kept uniform by means of steam in the cathode compartment, and this steam also assists in dissolving the caustic soda formed at the cathode as well as in heating the cell, and thus reducing its resistance. Should the pores of the diaphragm begin to close, due to the presence of excessively strong caustic liquor, they can be freed by increasing the amount of steam.

The normal operating period between renewals of the diaphragm is from six to eight months, and during this period the operating conditions remain practically constant. The cells are rated at 1,000 amperes, at which current the most efficient results are obtained, although they can be run as low as 600 amperes without serious loss of efficiency, and will stand a continuous overload of 10 per cent. without damage to the plant or product. The voltage drop is from 3.5 to 3.8 volts with a usual average of 3.7 volts over six months. Plant records show about 90 per cent. ampere-hour efficiency and a 60 per cent. energy efficiency. One of the best features of the cell is that it can be shut down either accidentally or intentionally for short or long periods as often as desired without damage to the cell or serious loss of efficiency. When operated at 1,000 amperes these cells are guaranteed to produce 60 lb. of chlorine and 68 lb. of sodium hydroxide per cell per 24 hours when supplied with a brine solution not exceeding 120 lb. of salt.

In the *mercury* type of cell anodes of carbon with a cathode of mercury are used. The sodium liberated by electrolysis amalgamates with the mercury, and the amalgam is transferred mechanically to an adjacent compartment containing

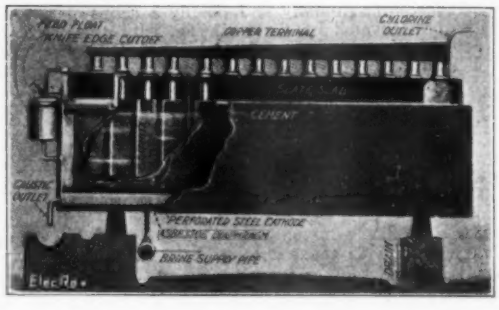


Fig. 1.—The Nelson Electrolytic Cell.

water, by which it is decomposed. Sodium hydroxide is formed with the evolution of hydrogen, and the mercury is freed, and is returned to the electrolytic chamber. The chlorine is collected above the anodes, and the caustic soda so formed is very pure.

In England the Castner-Kellner cell was an early representative of this type. Although the efficiencies are good the initial cost is extremely high. A plant having a capacity of one ton of chlorine per day would contain about 13,000 lb. of mercury. Other mercury cells are the Solvay-Kellner, the Rhodin, and the Wildermann.

The many advantages of the mercury cell are offset by the comparatively large capital outlay involved, and the large floor space required, coupled with the difficulty of removing the impurities from the mercury. The high fixed charges can only be compensated for by low energy costs, so that the mercury cell would appear to be restricted to regions of cheap electric power.

With the *bell* process no diaphragm or mercury is used; the partial separation of the caustic soda and salt solutions is effected by gravity. A bell of non-conducting material coated on its outer surface with sheet iron forms the cathode, and is supported in an open tank. Inside the bell a horizontally surpended carbon plate acts as the anode from which the current flows down through the salt solution, which is fed into the anode compartment, under the edge of the bell and up to the cathode. The chlorine evolved is drawn off through an opening in the top of the bell, and the heavy caustic soda formed at the cathode sinks and is drawn off at the bottom of the tank. The sodium chloride drawn off with the caustic soda crystallises out on concentration of the caustic soda by evaporation. In practice a tank contains 25 bells operating in parallel. Modifications of the original Aussig cell are the Jewell and the Jenkins.

The bell cells are free from diaphragm troubles, reliable in operation, and have small capital and maintenance costs, but they take up a large amount of room, and their energy efficiency is low.

Electrolytic chlorine plants constitute a load of the most attractive type for central stations. For many types of cells the steady amperage at low voltage may be taken directly from a rotary converter at the available pressure, say 110 to 500 volts. For example, cells using 1,500 amperes at 3.5 volts could be connected 30 in series on 110 volts, in which

* *Chemical and Metallurgical Engineering*, Vol. 21, No. 2, pp. 69-72 and Vol. 21, No. 3, pp. 133-136. Abstract.

case the required converter capacity would be 165 KW. Such a plant would produce, say, 2,880 lb. of chlorine per 24 hours. Voltage regulation is unnecessary. In addition, such a plant, equipped with the proper type of cell, would permit of off-peak operation.

The increasing demand for chlorine, its numerous products and by-products must lead to the development of a recognised standard type of cell comparable in efficiency, durability, and ease of operation with other electrical apparatus. This ultimate type of cell will doubtless have an energy efficiency above 80 per cent.; it will operate with little attention; it will be unaffected by any interruption in the electrical supply; its elements will, as in the case of the storage battery, require but infrequent renewals; and ordinary impurities in the salt and water will produce no effect upon its efficiency, and will be periodically removed as simply as a boiler is blown off.

That a wonderful expansion is assured to the electrical chlorine industry in the immediate future is an undeniable fact, and is one which cannot fail to attract the closest attention, not only on the part of the chlorine manufacturer and the industrial engineer, but those in charge of electricity supply.

TIDAL POWER.

So far no tidal power development of any appreciable size has been carried out, although the idea is an old one. The present high cost of fuel and water power development in general has, however, revived interest in the subject, and the commercial possibility of such schemes is at the moment receiving serious consideration both in this country and in France. According to an article on the subject in the June 3rd issue of *Nature*, from which the following particulars are derived, the power which may be developed from a tidal basin of given area depends on the square of the tidal range, and since the cost per H.P. of the necessary turbines and generating machinery increases rapidly as the working head is diminished, the cost per H.P. of a tidal-power installation, other things being equal, will be smallest where the tidal range is greatest. It is for this reason that the western, and especially the south-western, coasts of Great Britain, and the western coast of France, are particularly well adapted for such developments, since the tidal ranges are greater than in any other part of the world, with the possible exceptions of the Bay of Fundy, Hudson's Bay, and Port Gallelos, in Patagonia.

In Great Britain the highest tides are found in the estuary of the Severn, the mean range of the spring tides at Chepstow being 42 ft., and of the neap tides 21 ft. In France the maximum range occurs at St. Malo, where it amounts to 42.5 ft. at spring tides, and about 18 ft. at neap tides. The tidal range in the Dee is 26 ft. at springs, and 12 ft. at neaps, while the mean range of spring tides around the coast of Great Britain is 16.4 ft., and of neap tides 8.6 ft. The article briefly outlines and compares the five most promising schemes of development that have been suggested, and goes on to point out that the great difficulty in developing a tidal scheme as compared with an orthodox low head water-power scheme arises from the relatively great fluctuations in head. In the case of the Severn, for example, the working head at springs would be twice as great as at neaps, and the energy output per tide would be four times as great at springs as at neaps, while at St. Malo the output would be 5.5 times as great at springs as at neaps.

Not only is the installation subject to this cyclical fluctuation of head, but in any simple scheme the turbines also cease to operate for a more or less extended period on each tide; and this idle period will gradually work around the clock, and will, at regular intervals, be included in the normal industrial working day.

In any installation, then, designed for an ordinary industrial load, unless the output is cut down to that obtainable under the minimum head available at the worst period of a neap tide, in which case only a very small fraction of the total available energy is utilised and the cost of the necessary engineering works per H.P. will, except in exceptionally favourable circumstances, be prohibitive, some form of storage system forms an essential feature of the scheme.

Various storage systems have been suggested. Electrical accumulators must be ruled out, if only on account of the cost, and the same applies to all systems making use of compressed air. The only feasible system appears to consist of a storage reservoir above the level of the tidal basin. Whenever the output of the primary turbines exceeds the industrial demand, the excess energy is utilised to pump water into the reservoir, and when the demand exceeds the output from the primary turbines it is supplied by a series of generators driven by a battery of secondary turbines operated by the water from the storage reservoir.

Evidently this method is available only when the physical configuration of the district affords a suitable reservoir site within a reasonable distance of the tidal basin. Unfortunately also considerable losses are inevitable in the process. Where two tidal schemes at some distance apart differ sufficiently in phase, it is possible to work the two in conjunction, but this does not affect the necessity of storage as between spring and neap tides.

The prospects of tidal-power schemes would be much more promising if the whole of the output could be utilised as it is generated. By feeding into a distributing main in conjunction with a large steam station and/or inland water power scheme, and delivering to an industrial district capable of absorbing a comparatively large night load, such a state of affairs might be realised, at all events approximately. There is also the possibility that the intermittent operation of certain electro-chemical processes may be developed so as to enable any surplus power to be absorbed as and when available, and, if so, power developed tidally will probably prove cheaper in this country than that developed from any other source.

Owing to the relatively large variations in working head in any simple scheme, and to the small working heads, the design of hydraulic turbines capable of giving constant speed with reasonable efficiencies, and of moderately high speeds of rotation, is a matter of considerable difficulty. Modern developments, however, promise much better results in both these respects.

Even with such turbines, the number of technical problems to be solved before a tidal scheme of any magnitude can be embarked upon with confidence is large. The questions of single- *versus* double-way operation, of storage, of the effect of sudden changes of water-level due to strong winds, of wave effects, of silting in the tidal basin and of scour on the down-stream side of the sluices, of the best form of turbine and of generator, and of their regulation and of that of the sluice-gates, are probably the most important, though not the only, subjects to consider.

On the other hand, the possibilities of tidal power, if it can be developed commercially, are very great. Assuming a mean tidal range of only 20 ft. at springs, and 10 ft. at neaps, and adopting the single-basin method of development with operation on both rising and falling tides, each square mile of basin area would be capable, without storage, of giving an average daily output of approximately 110,000 H.P.-hours. In such an estuary as the Severn, where an area of 20 square miles could readily be utilised with a spring tidal range of 42 ft., the average daily output, without storage, would be approximately 10,000,000 H.P.-hours.

At the present time it is difficult to obtain even a rough estimate of the total cost of such a scheme, owing to the uncertainty regarding many of the factors involved. The whole question would appear to merit investigation, especially on matters of detail, by a technical committee with funds available for experimental work.

British Canals.—A Committee on Inland Waterways has been appointed of which Mr. Neville Chamberlain, M.P., is chairman, and Mr. Arthur Sharp, Development Department, Ministry of Transport, 8, Whitehall Gardens, S.W.1, is the secretary.

The terms of reference are: To consider and report as to:—

1. What portions, if any, of the inland waterway system of the country should be acquired by the Ministry of Transport with a view to improvement, and upon what terms; what should be the form of ownership of such acquired portions; whether under the State, through a Department of the Ministry of Transport, or through a Regional Trust, or by any other methods; and

2. If a trust be recommended, what should be its constitution and the nature of its governing body?

3. What improvement should be carried out in such acquired portions? What would be the cost of the improvement, and how should the necessary funds be raised? Whether such acquired or improved portions would become self-supporting, and, if not, what deficit would be involved, also what indirect advantage would be obtained to compensate therefor?

4. What method should be adopted to ensure that any improvement in the value of the frontages should be secured, in part at least, to the body carrying out the improvement to the waterway?

5. In what manner could co-operation best be developed between transport by water and transport by rail or road?

The Output of Coal.—According to figures quoted in the *Times*, the output of coal for the week ended May 22nd was 4,830,707 tons, against 4,860,668 tons in the previous week and 4,674,302 tons in the corresponding long week in Northumberland and Durham. The output of coal from mines under the Coal Mines Act, which had fallen from 287,411,869 tons in 1913 to 227,714,579 tons in 1918, rose to 229,743,128 tons in 1919. The number of persons employed was 1,191,313, an increase of 182,446 persons on the figures for the year 1918, and an increase of 63,423 persons on the pre-war year of 1913. The figures show an increase on the pre-war figures of 5.6 per cent. in the numbers employed, but a decrease of about 20.1 per cent. in the output. The average output per person employed underground fell from 332 tons in 1913 to 253 tons in 1919, and the average output per person employed under and above ground from 267 tons to 201 tons.

BUSINESS NOTES.

Cycles for Disabled Men.—A Rally and Demonstration of Cycles for war-maimed men is taking place to-morrow, Saturday, June 12th, at 2.30 p.m., in the Inner Circle, Regent's Park, London, N.W. It has been organised by the editor of the *Motor-Cycle and Motor Trader*. Eighteen British makers of hand-propelled and motor-assisted cycles have signified their intention of taking part in the Rally, with close upon 50 machines, but an open invitation is extended to all actual users of hand-propelled cycles in the London area to take part, and it is expected that in consequence fully 100 machines will be present. One of the firms participating is MESSRS. CARTERS, LTD., of New Cavendish Street, W., who are sending one of their electrically-propelled bath chairs.

Manchester Steam Users' Association.—The annual report of the above association for 1919, announces that the total number of members is now 2,006, and the total revenue for the year was £27,850, but there was a resultant deficit of £5,121. The gross number of inspections carried out was 22,256, and no boiler under inspection and guarantee burst during the year. The chief engineer received the honour of O.B.E. during the period covered by the report, for services in connection with the war.

Extension of the Uses of Rubber.—The Rubber Growers' Association has decided to offer £5,000 as prizes, in the form of a competition for ideas and suggestions for extending the present uses, or for encouraging new uses, of rubber. A pamphlet has been issued containing full particulars and conditions of the competition. Copies can be obtained from the Secretary of the Association, at 38, Eastcheap, London, E.C.3. There will be one prize of £1,000, three of £500, ten of £100, and £1,500 will be divided between the remaining compstitors whose suggestions are considered to be of value.

A Congress and Exhibition at the Hague.—A Congress of the Government and Local Roads Authorities will be held at the Hague from September 15th to the 26th this year. The Congress will consist of the Government engineers who have charge of the main roads, and the provincial councils and engineers who are responsible for the maintenance of the smaller roads, also the municipal authorities who have under their charge streets and town thoroughfares. An important feature will be that an exhibition is to be held at the same time of road-making materials, machinery, &c., and of the various makes of commercial motors suitable for road transport. As the question of road-making and maintenance is of increasing importance, in view of the development of road transport, the Exhibition Section of the Federation of British Industries, for the convenience of British manufacturers, has undertaken the representation of this exhibition in England.

With regard to commercial motor-cars suitable for road transport, no lorry manufacturers exist in Holland. There is only one firm manufacturing ordinary passenger automobiles, and only two firms manufacturing motor tires on a small scale. For the interest of British firms, manufacturers, and engineers, it may be said that the exhibits will cover everything to do with roads, including maps, models, and statistics, machines used in road-making, and all the equipment necessary for the beautifying and illumination of streets and thoroughfares. On the transport side, exhibits will cover motor-lorries, commercial vehicles, spare parts, tires, accessories, motor fuel, motoring equipment and clothing. The Federation is in possession of full information, and can arrange all details for those who wish to exhibit or to visit the exhibition. Inquiries should be addressed to the Exhibition Section of the Federation of British Industries, 39, St. James's Street, London, S.W.1.

Annual Outings.—The staff of MESSRS. PRIMROSE AND PRIMROSE, electrical engineers, Glasgow, held their annual sports outing at Whistlefield, on Saturday last. The principals, Messrs. James and Clifford Primrose and Mr. R. Spencer Smith, were present. There were several exciting and amusing contests, including a five-a-side football match between the various departments. Mrs. James Primrose presented the prizes.

The staff outing of the ELECTRICAL SUPPLIES CO., of 233, Tottenham Court Road, took place on Saturday, June 5th. The party travelled by motor char-à-bancs to Marlow, and carried through a very fine programme. At the luncheon, Mr. Percy L. Davies (managing director) thanked the staff for their energetic work during the past 12 months, particularly those who had borne the anxiety of the early days, and congratulated them on their having brought the year to such a successful termination. In the evening a concert programme, under the direction of Mr. S. A. Coleman, was rendered and thoroughly enjoyed.

The Strike at Levers and Co-partnership.—The electricians, E.T.U. men, who were recently on strike at Lever Bros., Port Sunlight Works, have had their co-partnership benefits cancelled.

The Wimbledon Dispute.—The dispute between the Corporation and E.P.E.A. with reference to the previous decision of the Corporation not to pay the bonus of £30 granted by the National Joint Board of Employers and Members of Staffs to the technical staffs of electricity supply undertakings has now been settled. The E.P.E.A. at the request of the Ministry of Labour and other authorities agreed to defer any action until after the meeting of the Council on the 2nd inst., whereat a resolution agreeing to pay the bonus was passed by the Council. This has been made effective by another resolution of the Council passed on the 4th inst., rescinding the previous resolution not to pay the bonus.

Mr. W. A. Jones, general secretary to the E.P.E.A., informs us that the satisfactory settlement of this dispute is due in no small measure to the persistent interest of the Electric Lighting Committee and its chairman, Councillor Hatherly-Mynott, in the staff of the department under its control, and the energetic measures taken by the Mayor, Alderman D. Stuart, to deal with the situation that had arisen.

The influence of the National Joint Board through its constituent associations was also an effective contributory factor to the settlement.

The Merchant Trade in Germany.—It is announced that a number of merchant and export firms in the electrical industry have formed a community of interests to protect themselves against the inconveniences which have arisen in connection with the supply of electrical manufactures to merchants and exporters by makers, and against the threatened stoppage of the export trade by Government measures, particularly the export duty of 6 to 10 per cent. of the value.

Motor-Cycle Records.—The new British motor-cycle records recently set up for 100, 150, 350, 400, 450, and 500 miles, and for 1, 2, 3, 8, 9, 10, 11, and 12 hours were made by riders using British magnetos—the C.A.V.

French Company Notes.—There has been established at Paris (95, Rue Saint Lazare) the Société Phénicienne de Force et Lumière, with a capital of 500,000 fr. for the utilisation of all forms of electric energy.

With a capital of 300,000 fr., the Société Voltampère has been constituted at Paris (30, Rue des Trois Bornes) for the manufacture and trade in electrical fittings.

Ferdinand et Jean Guerpillon is the style of a company formed at Paris (4, Rue du Borrégo) to carry on the business of electric measuring apparatus makers of Mrs. Graindorge. The capital is 250,000 fr.

There has been constituted at Paris, under the name of Chesni et Cie. (4, Rue Léon Cosnaro) a company with 100,000 fr. capital for the purchase, sale, and installation of electro-mechanical appliances, the installation of high and low-tension networks, power stations, transformer posts, &c.

The Société Andelysienne d'Electricité (11, Rue de la Tour des Dames, Paris) has written down its capital from 1,500,000 fr. to 750,000 fr., and increased its capital to 5,000,000 fr. Eventual increase to 10,000,000 fr. rests with the Directorate.

Hamès, Laborie et Cie. has been incorporated (109, Rue de Sèvres, Paris) for trade in electrical apparatus, more particularly an apparatus to prevent motor-car thefts.

The Société Hydroélectrique de la Haute Bourne, of Grenoble (capital 500,000 fr.) has been dissolved, its assets having been acquired by the Société Hydroélectrique de Vizille, which discharges the former's liabilities.

There has been formed at Lilas (Avenue Pasteur 98) as a company, C. Demarquest et Cie., for electrical and mechanical construction. Its capital is 150,000 fr.

Under the style of Le Progrès Mécanique L. Parmentier et Cie. has been constituted a company at Clichy (39, Rue de Villeneuve), with a capital of 100,000 fr. for the manufacture and sale of all kinds of telephonic, electrical and mechanical apparatus and accessories.

Australian Tariff Affects Tramways.—Schemes of tramway development in the Commonwealth, it is said, are likely to be checked, if not crippled, by the extra duties placed in the new tariff upon imported rails. A scrutiny of the tariff reveals that the duties on all steel rails, including tramway rails, have been raised from 17s. 6d. to 35s. and 65s. a ton, according to the country of origin. While these duties are intended to give extra protection to Australian manufacturers, it is pointed out that owing to plant suitable for the manufacture of tramway rails not being available it will be impossible for some considerable time to come to draw supplies from Australian sources.—*Melbourne Herald.*

British Empire Exhibition in London.—It is intended to hold in London in 1923, or at such earlier date as may prove possible, a great British Empire Exhibition, which will demonstrate the magnitude of the resources and productive power of all parts of the Empire. A meeting was held at the Mansion House on Monday last, at which communications from the Prince of Wales and the Prime Minister were read. Viscount Milner, Secretary of State for the Colonies, urged the claims of the Exhibition, and other speakers were the Right Hon. W. A. Watt, Sir George Perly, and Sir Robt. Horne (President of the Board of Trade). Mr. H. G. Williams, secretary of the Machine Tool Trade Association, speaking from the body of the hall, expressed regret that the Government had given approval to a long-period exhibition. Exhibitions were among the best advertising media, but six-months' exhibitions which formed a fair ground were not the best method of promoting British trade.

Plant for Sale.—Whitby Urban District Council invites offers for one 100-KW. Parsons turbo-alternator, and one 28-H.P. vertical-enclosed engine complete. Heckmondwike Urban District Council Electricity Department has for disposal one 75-KW. Reavell-Fowler generating set, and one 465/550-volt D.C. Fowler generating set. For further information, see our advertisement pages to-day

Catalogues Wanted at Charleroi.—The British Vice-Consul at Charleroi (Mr. J. P. Macgregor) reports that a special catalogue and sample room has been opened there, and he would be glad to receive catalogues (if possible in French) from British manufacturers, as well as small samples of all kinds, for exhibition. Notices are sent to the local Press at regular intervals of all catalogues and samples received, and every effort is made to bring these to the notice of Belgian importers.

Lead.—Under date June 5th, MESSRS. G. CAWSON & Co. report :—

The export demand has been very poor, and general trade seems to have become decidedly worse, so that home consumers are only taking very limited quantities of lead. Even the demand for electrical purposes appears to be falling off. If this situation continues, we are afraid the prices may further decline. There is no lack of lead coming forward; in fact, it is sometimes difficult to get rid of metal, as it arrives without going to the expense of warehousing. Reports from producing countries look more favourable.

On the same date MESSRS. JAMES FORSTER & Co. reported :—

There is no change in the general position. . . . There is still no quotation of lead on the New York market, a condition which has existed for weeks past. On the other hand, consumers, as is usual in such market conditions as this week, are little in evidence. Export business is quiet, and conditions in the City, financial and otherwise, continue to exert an adverse influence all round. It may safely be said that, with anything like normal consumption and conditions, the supplies to be expected in the next few months are totally inadequate.

Tasmanian Hydro-Electric Plant. — A newspaper report from Tasmania states that the State Hydro-electric Department is making extensive purchases of machinery in connection with developmental work at Waddamana, Lake Rolleston, Launceston, and Bridgewater. It is alleged by the Department that, despite the fact that all machinery which cannot be manufactured in Australia is supposed to be admitted free of Customs duty, Tasmania has to pay many thousands of pounds a year in duty on machinery from England and America which admittedly cannot be made in the Commonwealth. Mr. Hayes (Minister for Works) stated, in April, that under the new tariff the Hydro-electric Department would be hit very hard, and he hoped that something would be done by way of amendment before the proposals passed the Federal Parliament.

The Norwegian Aluminium Co.—The report of the A. S. Hoyangfaldene Norsk Aluminium Co., which was presented at the annual meeting held at Christiania on June 1st, states that the production of carbide, iron and electrodes had been discontinued and the remainder of the raw materials been sold. The production of aluminium was started, and would be increased gradually as larger supplies of alumina were received, which would depend, in the first place, upon the output in France. Unfortunately, considerable disappointment had been caused through the delay in the delivery of machinery by the European firms, but the machinery had now arrived, and experimental working for the essential part of the works had been begun. The work undertaken in the direction of the production of alumina from Norwegian raw materials was continued and brought to a close in the course of the year. The method had been carried out by an expert committee, who characterised it both technically and economically as possessing the competitive capability of solving the question of the production of alumina from native clay. As, however, the war was over, and the delivery of supplies of alumina could be reckoned on from France, the directors did not find any reason for the present for taking up the production according to this method. During the work of endeavouring to ensure further supplies of raw materials, they had paid special attention to comprehensive and valuable deposits in Surinam, Dutch Guiana. The subsidiary formed by the company—the N.V. Nederlandsche Mijn Exploratie en Exploitatie Maatschappij—in which the company held the majority of the shares, had now been granted a concession by the Dutch Government for these deposits. In the case of the A. S. Nordisk Aluminium Industri, of Holmestrand, which is also a subsidiary company, the report states that the installation had so far been completed that it had been possible to commence production. The accounts show a deficit of 1,336,000 kr. for the year, during nine months of which practically no manufacturing was carried on. As to the future prospects, the directors remark that the demand for aluminium is considerable, and prices are favourable, and should yield good profits as soon as the works are in full operation.

Italian Government Electrical Contracts.— During 1919 the Italian Government placed contracts for the following electrical plant :—

Copper wire	10,000,000	lire
Telephone cable...	4,000,500	,,
Telephonic apparatus	1,000,000	,,
Cord	350,000	,,
Dry and wet batteries	230,000	,,
Covered wire	220,000	,,
Insulators...	1,300,000	,,
Poles	750,000	,,

The above is exclusive of contracts for large canalisation works, power station equipment, &c.

German Representation.—Judging by copies of a letter which we have received personally, and had brought to our notice otherwise, a German firm of meter makers is circularising the electrical profession broadcast with a view to securing a London representative. A correspondent suggests that this is the beginning of "peaceful penetration"; but that, we believe, began again in November, 1918.

A Canadian Exhibition in London.—The Canadian Industries Exhibition, which was formally declared open by Sir G. McLaren Brown, of the C.P.R., on Monday last, remains open until 17th inst. It is being held at the Royal Agricultural Hall, Islington, and any reader who wants to come closely into touch with Canadian affairs should make an effort to inspect the exhibits during the remaining few days. The display affords a very convincing evidence of the great industrial strides that Canada has made since 1914, directly as the result of war-time manufacturing operations. Six years ago the exports of Canadian products were chiefly of agricultural and raw-material descriptions, but since the war-time factories have turned over to peace-time operations, an export trade in manufactured goods has been developed, which bids fair to reach large proportions. Sir G. McLaren Brown said that the possibilities of Canada industrially were limitless, by reason of her geographical position, her vast and varied national resources, her practically unlimited navigable waterways, her healthy climate, and the energy of her people all of which made for low cost of production, operation, and distribution. This had been recognised already by their cousins to the south of the border, and many American factories had been established in Canadian territory. As a Canadian, he was glad that the advantages of Canada as a country for manufacturing were coming to be recognised by manufacturers in England who proposed to establish branch factories. They would never regret it.

The exhibits are of a varied nature, indicating activity in steel products, polishes, gas engines, bicycles, steam-heating apparatus, leather goods, agricultural machinery, paints and varnishes, electric irons, toasters and vacuum cleaners, enamelled ware, furniture, pianos and organs, lathes and hand-saws, petrol engines, engineers' tools, and products of the Canadian Electro-Products Co., Ltd., and the Canada Carbide Co., whose works are at the Shawinigan Falls. At the time of our visit the Hoover electric suction cleaner was receiving a good deal of attention. Cinematograph films of general life in Canada, also industrial films, are being shown free in the King Edward's Hall, morning, afternoon, and evening. Mr. H. Greville Montgomery, who has been responsible for the Exhibition, is to be congratulated upon the measure of success that has attended his efforts, in spite of most exceptional difficulties. The Exhibition is the first of its kind held in London, but it will, unless we are mistaken, be followed by many others as Canadian export trade grows, as it seems destined to do, in the coming years.

British Engineering Firms and Manufacturing in Australia.—According to the Melbourne *Age* for April 12th, representatives of Vickers, Ltd., have been on a tour of inspection of the various engineering works in the Commonwealth for the purpose of investigating the possibilities of the extension of the engineering industry in Australia. The members of the party included J. S. Redshaw, shipbuilding expert; L. Lawrence, marine engines; Captain F. W. Turner, Rolls Royce engines; A. E. Meaden, motor cars. "It is believed that the firm of Vickers, Ltd., which at present has a contract for the construction of three of the 15,000-ton vessels for the Commonwealth Government, is contemplating the extension to Australia of the various branches of its activities, including shipbuilding, aeroplanes, &c." Amongst the party was Mr. W. L. More, the representative in Australasia for Boving and Co., manufacturers of water turbines, and he was also investigating the possibility of the machines being constructed in Australia instead of, as hitherto, being imported.

The Salvage of Oily Rags, &c.—Oily rags have hitherto been numbered amongst the things that are difficult to dispose of, except in a furnace; but the war has taught us many things with regard to the salvage of waste materials, and the Ministry of Munitions erected special plant for extracting oil from rags, which were afterwards cleansed and sold to textile or paper mills. The manager of this plant was Mr. L. St. Clare Roberts, who purchased it after the Armistice was signed, and transferred it to his new mills at Plaistow. A company has been formed under the style of Roberts, Paton & Co., Ltd., Chapel Mills, Eve Road, London, E. 15, which delivers steel drums, free of charge, to customers in the London area, or free on rails for country customers, and collects them when full of oily rags, paying for the latter. Rags are much cheaper than cotton waste, and are more absorbent; for these reasons they were adopted in all the workshops of the Royal Air Force, and engineering firms are following this example.

Company Liquidations.—ELECTRIC SMELTING CO., LTD.—Winding up voluntarily. Liquidator, Mr. G. A. V. Narraway, 36, Queen Victoria Street, E.C. Meeting of creditors, June 14th.

SURREY ELECTRICAL CO., LTD.—Meeting of creditors is called for June 17th, at 227-8, Gresham House, Old Broad Street, E.C.

ELECTRIC TRAIN LIGHTING SYNDICATE, LTD.—A meeting is called for July 6th, at 4, Central Bank Chambers, Leeds, to hear an account of the winding up from the liquidator, Mr. G. Parish.

ROTASPHERE, LTD.—A meeting of creditors was called for June 10th. Liquidator, Mr. A. S. Jopp.

FULLER'S WIRE AND CABLE CO., LTD., FULLER'S CARBON AND ELECTRICAL CO., LTD., THE FULLER ACCUMULATOR CO., LTD., and J. C. FULLER & SON, LTD.—Final meetings of members are called for July 7th at Keenan's House, Crown Court, Cheapside, E.C. Liquidator, Mr. H. M. Morris.

D. HULETT & CO., LTD.—A meeting of members is called for July 1st, at 1, Walbrook, E.C., to hear an account of the winding-up from the liquidator, Mr. J. D. Broad.

FALKIRK IRON CO., LTD.—Meeting of creditors at 43, Vicar Street, Falkirk, on June 21st. Liquidator, Mr. J. Hastings. This liquidation is for purposes of reconstruction. All creditors will be paid in full.

Catalogues and Lists.—THE IMPERIAL ELECTRIC WORKS, 7-12, Imperial Mews, St. Martin's Avenue, East Ham, E.6.—Illustrated leaflet describing Browning's electrically-heated soldering iron.

"RAINBOW" ARTISTIC SHADE CO., 30, Laurel Road, Fairfield, Liverpool.—An illustrated folder giving designs and prices of various types of silk lamp shades.

MESSRS. BRUCE PEEBLES CO., LTD., Edinburgh.—Pamphlet No. 21 D (20 pp.). An illustrated catalogue of self-contained, medium-size D.C. dynamos and motors. The list gives full specifications and weights and dimensions in British and metric units.

IGRANIC ELECTRIC CO., LTD., 147, Queen Victoria Street, E.C. 4.—Pamphlet No. 6,007, an illustrated leaflet entitled "Electric Coil Winding," showing various types of coils and windings.

Book Notices.—"Report of the Labour Co-partnership Association for the Year 1918." London. 3d.—The annual meeting takes place in London (at the Guildhall), on Wednesday, June 16th, at 3 o'clock. Lord Robert Cecil, K.C., M.P., will preside; Mr. W. A. Appleton will deliver address, and Sir George Gibb will be one of the other speakers.

"Umsturz der Einsteinschen Relativitätstheorie." By A. Patschke. Berlin-Wilmersdorf: from the author.

"Lectures on Industrial Administration." Edited by B. Muscio. Pp. vii + 276. London: Sir I. Pitman & Sons, Ltd. Price 6s. net.

Scientific Paper No. 374 of the U.S. Bureau of Standards. "An Integration Method of Deriving the Alternating Current Resistance and Inductance of Conductors" (32 pp.). Washington: Government Printing Office. Price 10 cents.

"Report of the British Chamber of Commerce of Turkey and the Balkan States (Inc.) for the Years 1914-19." Constantinople.

Bankruptcy Proceedings.—C. J. T. HAYMAN, electrical engineer, 76, Malvern Road, Leytonstone.—Receiving order made June 2nd, on debtor's own petition. First meeting, June 15th; public examination, July 16th, both at Carey Street, W.C.

BERNARD PORDES, lately carrying on business under the style of the United Electrical Manufacturers Co., at 18-22, Christopher Street, E.C.—Accounts have been filed at the London Bankruptcy Court showing total liabilities £7,190 (unsecured £6,525), and assets consisting of book debts for £448, estimated to produce £160. The debtor manufactured electric pocket-lamp batteries, and he attributes his present position chiefly to losses, estimated at £12,000, sustained through the supply of bad chemicals; also to loss of £2,000, costs of an action brought against him by a foreman for unjustifiable dismissal. The public examination was to have been held on June 8th, before Mr. Registrar Mellor, but Mr. W. Boyle, Official Receiver, reported that he had called upon the debtor to file cash and goods accounts, and both he and the trustee required time for purposes of investigation. By general consent the sitting was adjourned till July 20th.

A German Order.—According to the *South Wales Daily News* for June 4th, the A.E.G. turbo-alternator of the Newport Corporation Electricity Committee is out of repair, and the engineer reported that it was very likely it would be found impossible to find any firm in the United Kingdom willing to undertake the repairs. He thought that the Committee would have no alternative but to place the work with the A.E.G. Co., Berlin; but if this course was adopted it would be advisable to place an order for a new rotor, for which they had quoted £1,000 at a rate of exchange of 200 marks to the £1. The Committee recommended that the new rotor be purchased. The *Daily Sketch* of June 8th gave the price as £1,600, and stated that a section of the Council strenuously opposed the proposal to place the order in Germany, but the chairman of the Tramways Committee pointed out that as the original machine came from Germany, English firms would not consider its repair for fear their employés would refuse to handle it, and because they said they were overwhelmed with orders. The recommendation was adopted.

Cape Town.—The Electrical Trades Union sent in a demand, through the Federation of Trades' secretary, to the Electrical Contractors' Association at Cape Town for a minimum wage of 3s. 6d. per hour, with 75 per cent. of this amount for apprentices of four years' standing. The time limit was June 8th, at which date the demand of the building trades' employés for 4s. per hour also matured.

Trade Announcements.—MR. E. M. PARSONS, electrical contractor, who has been established at 67, King Edward Street, Hull, for over 17 years, is removing, on 14th inst., to larger premises at 38A, Brook Street, Hull. Telephone number unaltered: "Central 5180."

MR. F. J. HURST, for many years associated with the selling organisation of Messrs. Brown Bros., Ltd., motor and aircraft factors, has recently gone over to the Aircraft Disposal Co., Ltd., and is now installed at their sales headquarters at Regent House, Kingsway.

MR. P. BAXTER has commenced business as an electrical engineer at 29, Westgate, Grantham.

MR. G. C. BARNES, electrical engineer, has opened new premises at Regent Street South, Barnsley.

MR. A. B. CARTLAND has opened an office at 3, Creechurch Lane, Leadenhall Street, E.C. 3, where he is specialising in fuel-economising and smoke-abatement appliances, including the patent Sandwich system of boiler firing and the Gallagher-Crompton baffle bridge, also the boiler efficiency calculator.

Auction Sale.—By direction of the Disposal Board Ministry of Munitions, Mr. C. D. Phillips will sell by auction on June 22nd and following days at the National Carriage and Box Repair Factory, Newport, Mon., the factory plant, machine tools, electric motors, generating sets, &c. For full particulars see our advertisement pages to-day.

Dissolution of Partnership.—MUNDAY & PRIOR, agents and engineers, Belfast and Dublin.—Partnership dissolved. Mr. E. P. Prior has opened offices and stores at 44, King Street, Belfast, as wholesale electrical engineer, and has been appointed agent in Ireland for the Electric Construction Co., Ltd., the Sun Electrical Co., Ltd., and the New Pelapone Engine Co., Ltd.

Foreign Trade.—MAY FIGURES.—The following are the values of imports and exports of electrical goods and machinery in May:—

	May. 1920.	*Inc. or dec.*	*5 months,* 1920 *Inc. or dec.*
IMPORTS.	£	£	£
Electrical goods, &c. ...	111,417	— 12,717	— 119,699
Machinery	1,517,839	+ 404,834	+ 988,344
EXPORTS.			
Electrical goods, &c. ...	1,005,210	+ 555,640	+2,366,684
Machinery	4,851,193	+2,348,683	+9,352,068
RE-EXPORTS.			
Electrical goods, &c. ...	15,913	— 8,422	+ 8,450
Machinery	157,067	+ 94,657	+ 349,996

Copper and Lead Prices.—MESSRS. F. SMITH & CO. report, June 8th:—Copper (electrolytic) bars, £110, £1 increase; ditto sheets, no change; ditto wire rods, £125, £1 increase; ditto H.C. wire, no change; silicium bronze wire, no change.

MESSRS. JAMES & SHAKESPEARE report, June 9th:—Copper bars (best selected), sheets and rods, no change; English pig lead, £39, a reduction of 30s. on the week.

Draughtmen's Association.—At the half-yearly Conference of the Association of Engineering and Shipbuilding Draughtsmen, concluded at Blackpool, yesterday, the membership was stated to be over 15,000. Success in securing improved conditions was reported, and it was announced that the activities of the Association with regard to technical matters were increasing. Resolutions were passed protesting against the inclusion of draughtsmen and staff workers generally within the Unemployment Bill, and objecting to the further waste of public money on the maintenance of Employment Exchanges.—*Daily Telegraph.*

LIGHTING AND POWER NOTES.

Accrington.—PRICE REVISION.—The Corporation has appointed a Sub-Committee to consider a further revision in the prices of electricity, consequent on recent increases in coal and working charges.

Australia.—TASMANIAN WATER POWER.—Operations are to be commenced shortly upon the Lake Rolleston hydro-electric scheme, which has been designed to supply power to the Read-Rosebery Co. for treating zinc ore.

SYDNEY ELECTRICITY SUPPLY.—The Sydney undertaking supplies over 30 municipalities with electricity, and, as all the agreements were made before the war, charges have not been increased, with consequent loss to the city. The only safeguard possessed by the Council at present is to demand a guarantee that a certain minimum quantity of power will be taken, before new mains are laid. The City Council is endeavouring to get the municipalities concerned to agree to an increase in prices to place the undertaking in a better financial condition.

Barnstaple.—EXTENSIONS.—The Town Council, on May 31st, adopted a scheme for extending the electricity works at an estimated cost of £39,000. Mr. J. S. Highfield, the expert called in to advise on the extension, is to carry out the scheme on the terms quoted by him, namely, 5 per cent. on the total outlay.

Batley.—LOAN.—The Electric Lighting Committee is applying to the Ministry of Health for sanction to borrow £4,600 for mains extensions and services.

Belfast.—LOAN.—The Corporation is applying for sanction to a loan of £30,000 for expenditure upon the electricity undertaking.

Birmingham.—COMMITTEE'S REPORT.—A report of importance was presented at a recent meeting of the City Council by the Electric Supply Committee. It dealt with, among other things, the annual accounts of the department, which showed that the additional capital raised during the year amounted to £101,091, and the capital redeemed to £158,240. The outstanding debt was thus reduced by £57,149 to £1,881,628. The total amount of capital redeemed to date was equal to 34·3 per cent., and the net expenditure on this account was £110,879, chiefly in respect of the Nechells permanent station scheme. Dealing with revenue, the Committee stated that the quantity of electrical energy sold was nearly 128 million units, being a decrease of about 13 millions, or 9·22 per cent. There was a heavy fall during the earlier part of the year, but during the last half, the sales improved progressively,

being 22½ per cent. greater during the March quarter than in March, 1919. This improvement was maintained, and the gross revenue from consumers exceeded the previous year's total by 12·4 per cent. The increased expenditure and costs per unit were, to some extent, met by the authorised increases in charges to consumers which applied to the last seven months of the year. The principal increases in expenditure were in respect of coal, repairs, and rates and taxes, and wages had also advanced. The Committee explained further that considerable capital payments would have to be met before March, 1921, in respect of the Nechells permanent station scheme, and it was deemed necessary to set aside a further £10,000 towards meeting interest charges, &c., on this temporarily unproductive expenditure during the construction period. They considered also that it was necessary to strengthen the renewals and special expenditure reserve, in view of the present heavy costs of engineering works which were likely to remain at a high level for some time. Having regard to the recent advance of coal, it was necessary to revise the charges for electricity supplies. It was recalled that the City Council had sanctioned an increase in July, 1919, since which date, in addition to the present advance in coal prices, many other costs of production had increased. The additional rates on the assessment of the undertaking this year would amount to nearly £30,000 more than in the year just ended, whilst wages, salaries, repairs, &c., were estimated to cost a further £32,000. The addition to the department's coal bill, due to the present advance, would be nearly £70,000; a large proportion of this was, however, automatically recovered from the large power users on the terms of their high-tension agreements, and this also applied to traction supplies.

Blackburn.—Auxiliary Turbine.—Blackburn Corporation has authorised the purchase of a turbine at Throstle Street Destructor Works, in order that it may be run by steam supplied by the cleansing department to relieve the pressure on the electricity works during the winter months.

Burnley. — District Committee. — Burnley, Colne, Nelson, Accrington, and Rawtenstall have formed a District Committee to act together in all matters arising from the formation of a Joint Electricity Authority for this area under the Electricity (Supply) Act, 1919.

Loan.—The Town Council is making application to the Electricity Commissioners for sanction to borrow £45,000 (making, with £75,000 previously applied for, £120,000) for carrying out proposed extensions at the electricity works, and the purchase and installation of the necessary plant; also for sanction to borrow £20,000 for the installation of mains during the ensuing two years.

Burton-on-Trent.—Year's Working.—There was a net profit on the electricity undertaking during the past year of £1,427, as compared with £5,258 in the previous year. An additional capital expenditure of £2,385, however, has been contributed out of revenue this year, including £1,288 for an electric lorry. £1,000 of the profit has been contributed towards the relief of the rates, the balance being transferred to the renewal fund.

Ceylon.—Hydro-electric Project.—The *Times of India* states that the Ceylon authorities are considering a proposal to develop the island's water power. The initial cost of the scheme would be about nine million rupees, and a further three millions would be required for later extensions. The difficulty in obtaining machinery and the probable reluctance of power-plant owners to scrap their present plant are two great difficulties in the way of this proposal.

Darlington.—Extensions.—The Town Council is applying for sanction to borrow £104,000 for extensions to buildings and plant. Accommodation is to be made for two 5,000-kw. sets, but only one set and boilers will be installed at present.

Dartford.—Extensions.—The Urban District Council has applied for a loan of £14,928 for a boiler, duplicate bus-bars, mains extensions, and a rotary converter. A low-tension main to cost £1,865 is to be laid, in order to supply electricity to the works of Burroughs, Wellcome & Co., Ltd., and the Monazite Products, Ltd.

Darwen.—Mains Extensions.—Sanction to borrow £27,145 for extension of mains is being sought by the Corporation.

Dewsbury.—Loan.—The Electricity Committee recommends application for a loan of £4,000 to cover the cost of mains and services for supplying electricity to Savile Town.

Dover.—Loan Sanctioned.—Sanction to borrow £1,000 for mains extensions has been accorded the Town Council by the Electricity Commissioners.

Falkirk. — Extensions Approved. — The Electricity Commissioners have sanctioned the carrying-out of extensions to the electricity works. These extensions consist of generating and converting plant and mains.

Grays.—Loan.—The Urban District Council has applied for a loan of £1,500 for additional plant and mains.

Ilford.—Deficiency.—The Electricity Committee has received a letter from the Ministry of Health, stating that the appeal submitted by the Council against the disallowance of £10,261 8s. 1d., made by the district auditor at his audit of the accounts of the Council for the year ended March 31st, 1919, has been considered by the Minister of Health, and that it appears that the sum in question represents a deficiency on the Council's electrical undertaking at March 31st, 1919; that the Minister is of opinion that the disallowance was lawfully made, and he accordingly confirms the same, but before expressing any opinion as to the steps to be taken in dealing with this deficiency, he desires to be furnished with a report by the Council as to the prospects of its extinction. The Committee instructed the Clerk to inform the Ministry, in reply, that a rate of 5d. in the £ had been made for the ensuing half-year, to meet the deficiency on last year's working.

Leyton.—Year's Working.—The gross profit for the year ended March 31st last was £6,000. Of this amount half will be absorbed in payment of interest, and the other half placed to the reserve fund.

London.—Bethnal Green.—The Electricity Committee has recommended the installation of two 500-k.v.a. transformers at an estimated cost of £1,800; switchgear, £600; and the carrying-out of mains extensions at a cost of £7,740.

Morley.—Year's Working.—For the year ended March 31st last, the accounts of the electricity undertaking showed a total expenditure of £5,412, and a revenue of £7,883, the gross profit being £2,420. After paying off £2,138 in respect of interest on loans and sinking fund, there was a net profit of £281, as against a deficit of £1,759 in the previous year.

Bulk Supply.—The Corporation is considering terms for a supply of electricity in bulk for power purposes, and is in communication with the Electricity Commissioners regarding the matter.

Nottingham.—Electricity Supply.—A report, which was passed for its first reading, was presented at the last meeting of the Nottingham City Council, dealing with future provision for electricity supply. Mr. J. H. Rider had been engaged by the responsible committee to deal with the question of a modern power station for the Nottingham district, such station to form a part of the general scheme for the East Midlands, and to supply an area extending in all directions beyond the boundary of the city. He has recommended the erection of a new station on the banks of the Trent, the plant installed, in the first instance, to be two 10,000-kw. sets, and future extensions to consist either of 20,000-kw. or 25,000-kw. sets. His estimate of the cost of the complete plant, including land, buildings, machinery, &c., is for the first section of 20,000 kw. installed, £752,000 or £37·63 per kw.; first and second sections for 40,000 kw. installed, £1,009,000 or £25·225 per kw. These figures, which are based upon actual costs at the present time, include a certain amount of expenditure on behalf of the future, viz., the whole of the land, river works for discharge channel, engine and pump cranes, accumulators, &c. The estimate for the first section also includes buildings sufficient for 40,000 kw. of plant. It will also be necessary to provide high-pressure feeder cables between the new power station and the present generating stations in the city at an estimated cost of about £50,000. A certain amount of transformer plant will be required. The economies to be gained by operating the new power station, as compared with the two existing stations, will be very great. The committee proposes that application be made to the Electricity Commission for sanction to the borrowing of £868,000 for carrying out the first portion of the scheme.

Year's Working.—The annual report of the Electricity Committee, presented at a recent meeting of the Corporation, showed a surplus of £11,389, compared with a deficit of £8,912 in the preceding year. This is largely due to the increased charges which were put in operation for the last nine months of the period, together with the increase in the number of units sold. The demand is stated to be increasing both for lighting and power purposes, but there has been inevitable delay in making new installations, owing to the lack of necessary materials. The mileage of distributing mains at the end of the year was 72·793. The number of units sold during the year was 17,055,592—an increase of 764,422 for lighting, 624,360 for power, and 1,162,932 for traction.

New Zealand.—Extensions at Auckland.—In view of the inadequacy of the present plant, and of the fact that there is no immediate prospect of a hydro-electric supply, the City Council has decided to make large extensions to the electricity undertaking. The scheme adopted will entail an expenditure of £500,000.

Water Power.—Three large hydro-electric schemes are under consideration. The Wellington City Council proposes to develop the power of the Orongoronga River at a cost of £337,000, and the Wanganui Borough Council is borrowing £250,000 for the purpose of constructing a hydro-electricity works at the source of the Wanganui River, about 30 miles from the town. The third scheme is for the development of Lake Monowai to provide power for Southland. The cost of this undertaking will be £1,500,000.

Price Increases.—Consequent upon the recent increase in the price of coal, a large number of undertakings have found it necessary to raise their charges for electricity. Among these are:—Dewsbury, Swansea, Leicester, Barnstaple, Lincoln, Bangor, Darwen, Canterbury, Chester, Crewe, Dover, Maidstone, Motherwell, South Shields and Nottingham. The local company undertakings at Windsor, Sevenoaks and Carshalton have notified their intention to apply for permission to increase their charges.

Rotherham.—STRIKE.—The greater part of the electricity works was shut down on June 3rd, the employés striking in sympathy with the Sheffield workers. The men returned on Sunday, June 6th, and normal conditions were soon resumed.

South Shields.—LOANS SANCTIONED.—The Electricity Commissioners have agreed to sanction the borrowing of the sum of £31,439 repayable within 20 years.

With regard to a further application for sanction to borrow £37,513 for transformers, mains, sub-stations, &c., the Commissioners authorise the town clerk to let any urgent contracts or accept tenders for the works covered by the application, pending further examination of the figures by the Commissioners.

Turton.—ELECTRICITY SUPPLY.—The Urban District Council has had before it a scheme prepared by the Lancashire Electric Power Co. for the extension of the electricity undertaking. This provides for four distinct areas which, whilst complete in themselves, will be linked together. The estimated cost for the four areas is:—Bradshaw, £5,300; Egerton, £6,015; Horrobin £300; and Edgworth, £6,240; a total of £17,855.

The Council has accepted the scheme, and decided to apply to the Electricity Commissioners for power to borrow £20,000.

Wallasey.—DOCK DISASTER.—Following the Mersey Dock disaster, caused by the breaking down of a dock gate and the release of many thousands of tons of water from the Albert Dock, Birkenhead, the electrical services of the Wallasey Corporation were seriously interfered with at the beginning of the week. The generating station is near the Birkenhead Float, which immediately adjoins the Albert Dock, from which the station obtained its water supply. In consequence of the sudden drop of 8 ft., the water supply was practically cut off. The power supply was considerably reduced, with the result that the electric lighting throughout the town was very poor, and between 40 and 45 tramcars had to be taken off the various services.

Whitchurch (Hants).—LIGHTING SCHEME ABANDONED.—Owing to the lack of local support, the scheme to supply the parish with electricity by water power at the Tower Mill has been abandoned.

Wigan.—YEAR'S WORKING.—A profit of £13,071 was made during the year ended March 31st last, in spite of the fact that prices are much lower than the present average.

Woolston.—PURCHASE OF STATION.—The Town Council is considering the purchase of a local electricity undertaking, at a cost of £125,000.

Worthing.—YEAR'S WORKING.—A surplus of £1,206 was the result of working of the electricity undertaking for the year ended March 31st last, which compares favourably with the deficit of £2,154 on the previous year's working. The capital expenditure upon the electricity works is £100,000, of which £43,000 has been paid off.

Wrexham.—LOAN SANCTIONED.—The Town Council has been informed that there will be no inquiry with regard to the application for a loan of £17,000 for extensions to the electricity works.

York.—NEW PLANT.—The city electrical engineer has reported as to the cost of purchasing two Diesel engines, and of erecting and putting them in working order, together with foundations, cables, connections and contingencies, the whole amounting to the estimated sum of £18,640. The Electricity Committee recommends that it be authorised to proceed with the necessary purchases and completion of these works, and that application be made to the Electricity Commission for sanction to borrow the requisite amount.

TRAMWAY AND RAILWAY NOTES.

Ashton-under-Lyne.—FARES.—The Tramways Committee has refused to accede to an application from the Hurst Urban District Council to reintroduce penny stages.

Birmingham.—CANAL ELECTRIFICATION.—It is reported that electrification of an important part of the canal connecting Birmingham with the Severn at Stourport is to be undertaken shortly. It is calculated that the speed of the barges will be raised to 4½ miles per hour, about double that of horse haulage, and that the method of propulsion will allow of this speed without injury to the canal banks. An overhead trolley wire system is proposed. There is a considerable existing traffic on this portion of the canal, and scope for the development which electrification should render possible.—*Engineering.*

ANNUAL REPORT.—The Birmingham Tramways Committee has recommended the increase of the existing tramway fares by ½d. to meet the higher cost of administration. It states that it has had under consideration the estimated results of the current year's working of the undertaking, from which it would appear there would be a deficit of £283,537. The latter sum includes the cost of permanent-way renewals estimated at £200,000, which must be carried out during the year to enable the car services on some of the routes in the city to be operated with safety. The deficit could only be met by further increase of tramway fares. The Committee, in its annual statement of expenditure, points out that the amount borrowed for the tramway undertaking is £2,496,464. On the reserve account it is stated that the operating expenses show an increase of £166,091 due chiefly to the enormously increased cost of labour and material, and in a lesser degree to extra mileage—the average cost per mile being 17·184d., compared with 15·013d. for 1918-19, an increase of 2·171d. per car-mile. The receipts, which constitute a record in the history of the undertaking, amounted to £1,378,704, an increase of £131,433, the net result being, however, a loss of £34,659, as compared with last year's working. By the ½d. increase per fare, it is hoped to raise the additional income required to meet present liabilities. The Committee points out that the tram track has a length of 79 miles, or 123 miles (reduced to single); the traffic revenue last year was £1,371,978; average traffic revenue per car-mile, 21·538d.; and number of car-miles, 15,288,095. The average number of miles per car per day was 82, the average number of car-hours daily 10·92; the number of passengers carried was 225 millions; and the percentage of working expenses to receipts was 79 per cent. In a special report on the subject of fares, the Finance Committee urges that the Tramways Committee might with advantage report to the Council after, say, three months' experience of the proposed new fares in order that the Council might have an opportunity of considering whether the fares were sufficiently increased to cover the rapidly rising working expenses. The loss of the profits of the tramways was in itself a sufficiently serious matter for the Corporation without running the danger of the tramways becoming a charge upon the rates.

Bolton.—EXTENSIONS.—The Tramways Committee has under consideration the question of extending its system from the present terminus at Dunscar to a point near the Cross Guns, Egerton, and from the terminus at Tonge Moor along Bradshaw Brow, Lea Gate, to Longsight, Harwood. The Turton Urban District Council has deputed a Sub-Committee to meet the Tramways Committee to discuss the matter.

Bournemouth.—STRIKE ENDED.—Employés who were working upon the tramway track resumed work on June 2nd, after being on strike for a month.

Continental.—FRANCE.—The following particulars are gathered by the *Railway Review* from a statement by M. Claveille, Minister of Public Works and Transport:—It being highly important for France to make the most of its water power for generating electricity, particularly at a time when its supplies of coal are not sufficient to meet the needs of its industries, an inventory was made, at the end of 1916, of the available hydraulic power of the public water courses. The Special Committee on railroad service recommended the electrification of 5,220 miles of track as follows: Paris-Orleans, 1,926 miles out of a total of 4,839 miles; Paris-Lyons and Mediterranean, 1,367 miles out of a total of 6,040 miles; Midi, 1,926 miles out of a total of 2,525 miles. With the traffic of 1913, the energy consumption would have reached: Paris-Orleans, 280,000,000 KW.-hours; Paris-Lyons and Mediterranean, 550,000,000 KW.-hours; Midi, 330,000,000 KW.-hours; total, 1,600,000,000 KW.-hours a year. With the estimated traffic in the immediate future, the consumption would be: Paris-Orleans, 560,000,000 KW.-hours; Paris-Lyons and Mediterranean, 1,100,000,000 KW.-hours; Midi, 600,000,000 KW.-hours; total, 2,260,000,000 KW.-hours. In determining upon lines to be electrified, the Midi and the Paris-Orleans considered the relation of the cost of electric power as compared with the cost of power with steam locomotives, and the comparison showed that mountain lines with sufficient traffic should be among the first to be electrified. They also considered the location of the source of hydro-electric energy in relation to the lines, and the importance of this power to other industries. On the Paris-Lyons and Mediterranean, however, the possibility has been considered of using electricity on lines of low grades where there is a heavy traffic, even before mountain lines where the traffic is very small. The proposed sources of electric power are the following: For the Paris-Orleans, the Upper Dordogne river and its branches; for the Midi, the Pyrenees mountains; for the Paris-Lyons and Mediterranean, waterfalls in the central plateau and in the Alps, and the plant at present existing, or about to be constructed, in the region. The probable cost is estimated as follows, based on prices before the war: Paris-Orleans, $94,000,000; Paris-Lyons and Mediterranean, $93,000,000; Midi, $148,000,000; total, $335,000,000.

AUSTRIA.—In connection with the projected electrification of that part of the State railway system which is situated in the Alpine districts, it is proposed to extend existing and erect new hydro-electric power stations in different parts of the country, which are to supply 24,000 H.P. The length of the railways to be electrified is about 650 km., and the cost is estimated at 3,560 million crowns, which amount would have to be raised by a loan. According to figures supplied by the Government, the pre-war cost of the proposed works and of the rolling stock required probably would not have exceeded 80 million crowns.—*Financier.*

HUNGARY.—The State Railway authorities propose to electrify their lines, covering a total of about 1,400 km. This work is to be carried out during a period of nine years. Owing to the fact that all the waterfalls have been lost to Hungary, it will not be possible to utilise hydro-electric power, so other means will have to be used to generate the necessary power.—*Financier.*

Doncaster.—PROBABLE FARE INCREASE.—The tramway fares in the town and district will shortly be increased in consequence of the heavy costs which have now to be borne in maintenance, wages, &c. The present fares are only 1d., and it is stated that since March last the Corporation has been losing £100 per week on the undertaking. It is probable that new routes will be opened out to the Carr House, Rossington, and Kirk Sandall districts.

Exeter.—Year's Working.—The total of the traffic receipts for the past year was £31,336, and the expenditure, exclusive of loan interest, &c., was £28,444, leaving a gross profit of £2,892.

Leeds.—Fare Increase.—At a recent City Council meeting, it was decided to increase the fares, after the first 1d. stage—which remains as it is—by ½d. per fare. About one-third of the passengers will not be affected by the increase, and about 50 per cent. will have to pay the increase from 1½d. to 2d. A loss of about £300 per day was being incurred, and it is expected that the present deficiency of £100,000 will be liquidated by the advanced fares. The Labour Party put up a strong opposition to the proposal, but their amendment to again refer the matter back for consideration was defeated. The increased charges will come into operation immediately.

Lincoln.—Fare Increase.—There was a net profit on the tramway undertaking of £313 on the past year's working. It has been decided to increase the tramway fares from 1½d. to 2d., the 3d. (workmen's four-journey) fares to 4d., and the parcel rates in the same proportion.

Liverpool.—Price Increase.—The Corporation has decided to increase the basic charge of 1d. per unit for electrical energy supplied to the tramway undertaking by 15 per cent. from June 30th, and a variation for fuel price adjustment is to be added to the increased charges.

London.—High-Speed Cars.—A new main road from West Ham to Tilbury, to serve the new suburb which the London County Council is erecting at Dagenham, is to have a double tramway track down the centre, fenced off from the rest of the road, to allow the cars to run at high speed.

Manchester.—Stage Reduction.—To meet the anticipated serious deficit on the current year's working of the tramways, the Tramways Committee decided to reduce the 1d. stage in distance from 2 to 1½ miles, and this has been confirmed by the City Council.

Salford.—Stage Reduction.—To meet the increased cost of running the tramways, the Town Council last week decided to reduce the 1d. stage to 1½ miles, instead of 2 miles, as at present. An amendment was proposed to put an extra ½d. on 1d. fares, but was defeated.

Sandwich.—Time Extension.—The East Kent Light Railway Co. has informed the Town Council that it is applying for an extension of time for the construction of the line from Shepherdswill to Sandwich, *via* Barfrestone, Eythorne, Eastry, Woodnesborough, Ash and Stonar, and the application is to be assented to.

TELEGRAPH AND TELEPHONE NOTES.

Australia. — Arc Wireless Installations. — The Minister for the Navy stated that the Naval Board had approved of the installation of the arc system of wireless telegraphy at certain Australian stations. The four installations that had been made were working successfully. The cost of the Melbourne and Perth stations was approximately £890. The Randwick wireless works had made 25 wireless receiving sets at a cost of £110 per set.

Communication with Russia.—The Great Northern Telegraph Co. has been negotiating lately with Litvinoff, over the resumption of telegraphic connection with Russia, which was broken off at the beginning of the war. The company's two cables can quickly be resumed, only the cable between Libau and Petrograd needing repairs.—*Central News.*

Greece.—Foreign Telegrams.—The Greek Administration notifies that the English, French, Italian, and German languages are admitted in international telegraphic correspondence until further notice.

High-speed Telegraphy.—A telegram to the Prince of Wales, giving the result of the Derby, was handed in by the King at Epsom at 3.16 p.m. It was transmitted to London, thence to Halifax (Nova Scotia), reaching Canada at 3.19 p.m., crossed the country, and by means of the Imperial Pacific cable the message reached Australia 23 minutes after the finish of the race.

Japan.—Telephone Extensions.—According to the *Taisha Nichi*, the Japanese Communications Department plans a big extension of the telephone service to be carried into effect during the next eight years beginning with the next fiscal year (from April 1st) at the estimated cost of yen 337,000,000. The present number of subscribers in Tokio is to be increased to 152,000; in Osaka to 91,000; in Kyoto to 30,000; in Yokohama to 21,000; in Kobe to 31,000; in Nagoya to 28,000; and in other places to 327,000. The above figures show the proportion of 49 subscribers per 1,000 population for Tokio; Osaka of 44; Kobe of 43; while others come to a rate of 40 or so. By 1926 Kobe will have six telephone exchanges, including the present three, to deal with the proposed extension. The city of Kobe now contains 9.100 or so subscribers, a number which is to be increased to 31,000. The Communications Department is at present studying the automatic exchange system now in vogue in America and Europe. The present 40 telephone circuits between Osaka and Kobe are to be increased to 100 in some places.—*Economic Review.*

Proposed New Cables.—Various announcements have been made from time to time regarding the laying of new cables, and the following particulars will show that cable factories will be very busy for some time to come:—The Commercial Cable Co. contemplates the laying of another Atlantic cable. Another Atlantic cable is contemplated by the Imperial Government, and one between Scandinavia and America. The Eastern companies are laying cables between England and Gibraltar; Malta and Alexandria; Aden and Bombay; Gibraltar and Malta; Madras and Singapore. A duplication of the British Columbia-Fanning Island cable may also be undertaken. Further cables are to be laid between Miami and Barbados; Barbados and Para; Buenos Aires and Monte-Video; Monte-Video and Santos. The West Coast of South America Co. intends extending its cables northwards; the Commercial Pacific Cable Co. will be duplicating its cables and the South American Cable Co. is establishing landlines between Buenos Aires and Monte-Video, and laying a cable between the latter place and Rio Janeiro. There has also been talk of connecting San Francisco by cable to Central America.

The Times announces that the Pacific Cable Board points out that the duplication of the Vancouver to Norfolk Island cable has not yet been considered by the Governments interested.

Signal Service Vacancies.—The War Office is appealing for a number of wireless operators and wireless electricians for the Signal Service. The normal period of engagement will be for six years with the Colours and six with the Reserve, but ex-soldiers and men who have not been in the Army will be accepted for two, three, or four years. A bounty of £100 will be paid to operators and £50 to electricians who pass the necessary tests.—*Times.*

Spain.—New Cable.—The Government intends, says the *T. and T. Age*, to lay a submarine cable between Cadiz, Spain, and Larache, in Morocco.

Telephone Exchanges. — Building Stopped. — The Cabinet Sub-Committee on Retrenchment has decided that all buildings for, amongst other things, telephone exchanges, are not to be proceeded with for the present.

Telephones in Rural Districts.—Mr. Illingworth, Postmaster-General, states that during the last 15 months over 500 new telephone call offices have been approved in rural districts, and some of these could be of benefit to farmers.

"I hope," he adds, "that when more progress has been made in overtaking the arrears of work which accumulated during the war, it may be possible more freely to extend the 'phone facilities in rural areas."—*Daily Dispatch.*

Wireless Meteorological Reports.—The Air Ministry states that on and after June 1st meteorological reports for general use will be circulated by wireless telegraphy daily. Synoptic telegrams in the code hitherto used will be issued at 3.15 a.m., 8.45 a.m., and 8.15 p.m. A General Inference, in plain language, based upon the 7 a.m. and 6 p.m. observations, will be issued at 9.15 a.m. and 8 p.m. Call sign G.F.A., wave length 1,400 metres (C.W.). The synoptic telegrams from Aberdeen at 2.30 a.m. and 2.30 p.m. are unaltered. Call sign B.Y.D., wave length 3,300 metres (C.W.). The times given are G.M.T.

Wireless Telephones.—Radio-telephone stations to be used primarily for giving information as to the whereabouts of aircraft travelling, or about to travel, along a route, and for reporting weather conditions along the route to the machine, are being opened in various parts of this country, France, and Belgium. Stations are already open for work at Croydon and Lympne for the London—Paris and London—Brussels routes, and stations will shortly be opened for the London—Birmingham—Manchester—Glasgow route at Castle Bromwich, Didsbury, and Renfrew.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review in which the "Official Notice" appeared.)

OPEN.

Australia.—Sydney.—August 4th. N.S.W. Government Railways and Tramways. Two 1,000-kw. sub-station units. Chief Electrical Engineer, 61, Hunter Street, Sydney.

August 3rd. Department of Public Works. Turbines and generators for the Barren Jack hydro-electric development scheme. Department of Public Works, Sydney.

N.S.W.—Postmaster-General's Department. August 2nd and 5th. Aluminium sheet, brass rod, &c., scheduled 769; platinum wire, gold and silver wire, scheduled 768. (See this issue.)

Western Australia. — Postmaster-General's Department. August 3rd. 326 accumulators, schedule 668. (See this issue.)

Barnsley.—Electric light installation at Westgate Primitive Methodist Church. Mr. P. Pickersgill, 122, Dodworth Road.

Belgium.—June 23rd. The Société Nationale des Chemins de Fer Vicinaux, 48, Rue Monteyer, Brussels. Tenders for about 3,400 metres of underground armoured feeders for the electric railways in the Namur district. Particulars from the Services Electriques Department, at the address given above.

Bedford. — June 21st. Electricity Department. One 2-ton locomotive jib crane, with grab and track rails, steam and other pipework. (June 4th.)

Belgium.—June 19th. The Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels, are inviting tenders for the supply of 1,710 kilometres of covered copper wire.

Canterbury. — June 22nd. Electricity Department. 1,210 yards ·25 sq. in. × ·25 sq. in. × ·125 sq. in. L.T. triple-concentric paper-insulated cable. (See this issue.)

Carlisle.—June 25th. Electricity Department. One 3,000-KW. turbo-alternator and condensing plant. (May 28th.)

Colne.—Electricity Department. Steam and water piping. (See this issue.)

Dartford.—June 26th. Electricity undertaking. Rotary converter, transformers, switchgear, &c., L.T. twin cable-feeder, pillar and feeder-panel. (See this issue.)

Dundalk.—June 15th. Urban District Council. Electricity Department. 750 yd., L.T., 3-core, paper-insulated, lead-covered and armoured cable; disconnecting boxes (pavement type) and joint boxes. (May 28th.)

Dundee.—June 24th. Electricity Department. Steam feed and water piping, two turbine-driven feed pumps. (See this issue.)

Edinburgh.—June 19th. Electricity Supply Department. E.H.T. and L.T. switchgear, &c., for Portobello station. (May 21st.)

Halifax.—June 18th. Tramways and Electricity Committee. Two natural draught chimney type water-cooling towers. (See this issue.)

Ince-in-Makerfield.—June 15th. Urban District Council. Waterworks Department. Motor-driven pumping sets; cables; alterations to winding engine from steam to electric drive; switchgear. (May 28th.)

Ingleton.—Ingleton Electric Lighting and Power Co., Ltd. Waterway across the River Greta. Particulars from Electrical Engineer to the Company, Electricity Works, Ingleton, *via* Carnforth.

Leeds.—June 14th. Electricity Department. 12,000-KW. steam turbine, alternator and condensing plant. (May 14th.)

London.—WIMBLEDON.—June 12th. Electric Lighting Committee. Two boilers, with mechanical stokers, induced-draught fan and motor pipework, steel chimney, &c. (May 28th.)

Manchester.—June 25th. Electricity Committee. Twelve months' supply electricity meters, time switches, potential and current transformers, motor-starting switches, C.C. and A.C. motors. (See this issue.)

New Zealand.—AUCKLAND.—September 1st. Harbour Board. For the supply of electric capstans and spares. Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, Cripplegate, London.

Newport.—June 26th. Electricity Department. Turbo-alternating plant, surface-condensing plant, boilers, economisers, draught plant, steel flue and stack, &c. (June 4th.)

Nottingham. — June 17th. Electricity Committee. Twelve months' supply of general stores. (See this issue.)

Nuneaton. — June 30th. Electricity Department. 1,000-KW., D.C., geared turbo-alternator, surface-condensing plant and pipework. (June 4th.)

Southampton. — July 3rd. Electricity Department. E.H.T. and H.T. switchgear and D.C. control panel. (June 4th.)

Swindon.—June 26th. Electricity Department. 2,000 yards 3-in. four-way stoneware conduits, light steel poles for overhead lines. (See this issue.)

Warrington.—June 15th. Electricity and Tramways Committee. Motors and transformers. (May 28th.)
June 29th. Electricity Department. Truck type ash elevator and hopper. (See this issue.)

CLOSED.

Australia.—SYDNEY.—City Council. Accepted.

Motor starters (spec. 500 sec. a. b. c. d.), £531; two 2,000-K.V.A. 5,000/10,000 three-phase oil-insulated water-cooled transformers for Pyrmont Power House (spec. 571), £5,015: two 2,000-KW. rotary converters (spec. 585), £31,400, Metropolitan-Vickers Electrical Co., Ltd.

Commonwealth, P.M.G.'s Department, Victoria.

Automatic switchboard equipment for Malvern, £12,658.—Automatic Telephones (Australia), Ltd.—*Tenders.*

Melbourne City Council. Accepted:

2,000 condenser tubes, £1,278.—H. V. McKay.—*Tenders.*

Belgium. — Seven home concerns submitted tenders recently to the municipal authorities of Antwerp for the electrical equipment of three transformer cabins at the Nos. 2 and 3 dock, the lowest being that of M. L. Desmedt, of Brussels.

Bradford.—Tramways Committee:

15 tons steel fishplates at £32 10s. per ton.—Walter Scott, Ltd.
10 tons C.I. brake blocks, £245.—Pease & Partners.

Electricity Committee:

Meter-testing generator, £505.—J. H. Holmes & Co.
Steam wagon for cable-drums and transformers, £1,300.—Yorkshire Commercial Motor Co., Ltd.
Steam piping, £855.—Stewarts & Lloyds, Ltd.
Fibre cable conduits, £2,512.—Key Engineering Co., Ltd.
Feed-water heater, £940.—Worthington Pump Co., Ltd.
Two hand-operated overhead cranes, £873.—Herbert Morris, Ltd.

Bolton.—Electricity Committee. Accepted:—

Worthington-Simpson, Ltd.—Condensing plant.
Stewarts & Lloyds, Ltd.—Steel piping for extensions at the Back-o'-th'-Bank electricity works.

Dartford.—Urban District Council:

Boiler.—John Thompson Water-Tube Boilers, Ltd.—£5,641.
Duplicate bus-bars.—Johnson & Phillips, Ltd., £765.
Improvement of fire-alarm system.—E. E. Beaven, £460.

Dover—Board of Guardians:

Electric light installation, workhouse.—E. A. Pinto, £463.

Hammersmith.—Electricity Committee. Accepted:—

198 meters, various sizes, £663.—Electrical Apparatus Co.
148 house service boxes, £148; two disconnecting boxes, £15; 150 fuse boxes, £211.—W. Lucy & Co., Ltd.

Mains Extensions.—Switchgear; two-phase H.T. board, three-phase E.H.T. gear, sub-station equipment, isolating switches for existing boards:—

		Delivery	Recom.
Ferguson & Pailin	**£11,107**	18 to 19 weeks.	
G.E.C. Co., Ltd.	19,934	,,	40 ,,
A. Reyrolle & Co., Ltd. ..	20,147	,,	Not stated
Switchgear & Cowans, Ltd. ..	20,148	,,	32 to 36 weeks
Park Royal Engineering Co. ..	23,300	,,	28 ,,
Met.-Vickers Elec. Co., Ltd...	24,546	,,	40 ,,
New Switchgear Con. Co., Ltd.	25,430	,,	40 ,,
Johnson & Phillips, Ltd. ..	27,260	,,	52 ,,

Cable Ducts.—Reference to the tender of Messrs. Sankey & Co. for cable ducts, accepted by the Council on April 28th. The firm notify that an award of the Industrial Reconstruction Committee for the clay industries has advanced the wages of the men by 8s. per week, and that this will increase the estimate by £153. As a stipulation was made in the company's tender providing for increased prices, the Committee has agreed to accept the revised offer.

Cable.—1,000 yards ·1 L.T. concentric cable, £358; 500 yards ·2 L.T. ditto, £304:—

Western Electric Co., Ltd., accepted.

Kingston-on-Thames.—Education Committee:

Electric light installation, manual training centre.—H. Offer.

Liverpool.—Corporation. Metropolitan-Vickers Electric Co., Ltd.—Switchgear, &c., in connection with the new 12,500-KW. generating set for the Lister Drive power station.

The Corporation has rescinded the acceptance of the tender of the Edison Swan Electric Co., Ltd., for the supply of insulated cables and wires for the 12 months ending March 31st next, and has accepted that of the Liverpool Electric Cable Co., Ltd.

London.—ST. MARYLEBONE.—Electricity Supply Committee recommended four 35-H.P. slow-speed motors and switchgear for the cooling-tower fans.

		Delivery	
W. Hallen, Son & Co. (recommended) ..	**£2,763**	7 to 8 months.	
British Thomson-Houston Co., Ltd. ..	2,793	,,	8 ,,
English Electric Co., Ltd.	3,116	,,	12 to 14 ,,
Metropolitan-Vickers Electrical Co., Ltd.	3,914	,,	10 ,,

Two turbine-driven rotary pumps, capacity 15,000 gallons per hour: £1,179, Messrs. Weir (recommended).

Circulating water pipes and valves: Aiton & Co., £1,856 (recommended).

Cables for generator and rotary converters:

British Insulated and Helsby Cables, Ltd. (recommended)	**£2,779**
Western Electric Co., Ltd	2,853
Callender's Cable and Construction Co., Ltd.	3,089
Pirelli-General Cable Works, Ltd.	3,152

House-service Meters.—The Committee recommends that the Council enter into contracts with Messrs. Chamberlain & Hookham, Ltd., and Ferranti, Ltd., for an indefinite number of meters, on the basis of their second alternative offer, for a period of one year.

General Purposes Committee. Set of Magneta electric clocks for the Town Hall, including master clock, 39 secondary wall clocks, and nine secondary mantlepiece clocks, &c.: £357, Magneta Time Co., Ltd. (recommended).

Motherwell.—Town Council:

Electricity meters for a year.—Chamberlain & Hookham, Ltd.

Poplar.—Borough Council:

Electric light installation, 144 houses.—Farndons Electric Co.

South Africa. — STRAND (CAPE PROVINCE). — Electric lighting for the municipality, Hubert Davies & Co., Ltd.

OUDTSHOORN (CAPE PROVINCE).—Hubert Davies & Co., Ltd., for the supply of the additional generating plant.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 11th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Faraday Society.—Monday, June 14th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Society of Engineers.—Monday, June 14th. At Burlington House, Piccadilly, W. At 5.30 p.m. Lecture on "Great Engineering Adventures," by Mr. E. Cressy.

Institution of Electrical Engineers.—Wednesday, June 16th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Discussion on the following: Paper read by Sir Dugald Clerk, F.R.S., before the Royal Society of Arts, on "Distribution of Heat, Light and Motive Power by Gas and Electricity"; and on "The Report of the Coal-Gas and Electrical Supply Industries of the U.K. to the President of the Institution of Gas Engineers," by Sir Dugald Clerk, F.R.S., Prof. A. Smithells, F.R.S., and Prof. J. W. Cobb.

NOTES.

Inquiry.—Agents for the "Edel" electric iron are asked for.

Appointments Vacant.—Lecturer in electrical wiring, for L.C.C. Hackney Institute; armature winder, for the Rochdale Corporation Tramways; electrical engineer (£1,000), for the Southampton Corporation; head of mining department (£375), head of engineering department (£375), for the St. Helens Municipal Technical School; electrical engineer (£10,200; the Straits dollar is fixed at 2s. 4d.), for the George Town (Penang) Municipal Commissioners; two cable foremen (550 rupees per calendar month), for the Telegraph Department of the Government of India; shift engineer (94s. 2d.), for the Rawtenstall Corporation Electricity Department; mains assistant, for the Sale Urban District Council Electricity Department: assistant mains engineer (£290), shift charge engineer (£276), for the Walsall Borough Electricity Supply Department; lecturers in physics, electrical and mechanical engineering for the Birmingham Municipal Technical School. See our advertisement pages for particulars.

Educational.—IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—On Friday last a public meeting was held at the Central Hall, Westminster, in support of the claim of the College to be invested with the power to confer degrees. Lord Morris presided, and amongst the speakers were Prof. Watts, Mr. H. G. Wells, Sir Ernest Rutherford, Mr. J. A. Spender, and Sir Alfred Keogh. The great majority of the large audience consisted of students of the Imperial College. A resolution urging the Prime Minister and educational departments to consider the matter seriously was moved from the chair, Lord Morris adding that if their aim was not accomplished in the regular way, there was another way to attain it. The resolution was carried, with one dissentient.

CAMBRIDGE UNIVERSITY.—The Commercial Union Assurance Co. has presented a sum of £165,000 to build and endow a laboratory for research in biochemistry.

Electricity in Steel Making.—At a meeting of the London Section of the Igranic Engineering Society on June 2nd, an interesting lecture on "Our Part in Steel Making" was delivered by Mr. C. W. Yerger, M.A.I.E.E. The lecture covered a great deal of ground, the industry being traced from the coal and iron mines and limestone quarries to the finished products of a variety of descriptions. Dealing with the mines, the lecturer enumerated the many ways in which electricity entered into the working and described hoists, air compressors, pumps, locomotives, &c. The coke ovens then received attention, and many facts concerning belt conveyors, cranes, breakers, crushers, door-operating gear and other plant were presented to the audience, and by means of lantern slides, members were enabled to obtain a good idea of the ingenuity of the machinery. The electrical plant utilised in the blast-furnace process was given a good deal of time, and some excellent photographs of car conveyors for delivering the iron, coke, &c., at the furnace top were exhibited. Methods of using the blast-furnace gas were detailed, part being used for heating purposes, and part for the generation of electricity. The steel works and rolling mills with their powerful motors and generators were illustrated and described. Special attention was accorded the electric cranes, and the magnetic braking devices for operating upon any failure of power were exhaustively dealt with, much interest being evinced in the arrangement by which a torque motor connected in parallel with the main motor, operating a cam gear acts against a spring while in motion, releasing this to operate the brakes when the power is cut off.

Fatalities.—The Deputy-Coroner for Newcastle-on-Tyne inquired, on June 2nd, into the death of two men, which occurred while they were working on the mains of the Newcastle and District Electric Lighting Co., Ltd. The two victims were Thomas Farrer, a foreman jointer, and Murray Kennedy, an assistant foreman. George Carr, mains superintendent to the company, said on May 29th a complaint was received from a picture hall in Scotswood Road that they could get no light. Upon an inspection of the mains, witness found that the fault was in a pipe at the junction-box at the top of Forth Banks. A short circuit had been set up on a Scotswood Road cable, which had set fire to other cables. The junction-box contained eight pairs of cables. The circuits were disconnected at the sub-station, and left till Sunday, when repair-work was recommenced. Seven pairs of cables were discovered to have been burned through in the pipe, some 2 to 4 ft. from the box. One cable was intact. In order to identify the cables, the whole were pulled out and labelled. After testing the cables to see they were otherwise all right, it was decided to rejoin those cables necessary to get the current on to supply places of worship with light, and leave the Scotswood cable till last. At 5.30, five pairs of cables were jointed, and it was decided to put the current on. Before doing so, witness read to Farrer a list he had received from Mr. Cowe, the foreman in charge of the jointing. That was done in Mr. Cowe's presence, and witness asked if it were correct. The reply was in the affirmative. Witness then went to the power station and gave the list to the station engineer; proceeding thence to the sub-station, the switches were put in. In a few minutes a telephone message was received, asking that the circuits should be made dead. On examining the cables afterwards, witness found that the Scotswood B cable was fully jointed, but the Westgate B cable was only partly jointed, and he found that the two men had been working on the Westgate B when the current had been turned on. It was evident that the deceased must have made a mistake, and connected Scotswood B, instead of Westgate B, and given Westgate B as a finished circuit. R. T. Cowe, foreman cable layer, spoke to receiving the names of the finished cables from Farrer. After the accident he pulled Kennedy off the wire. Farrer had evidently made a mistake between the two cables. Witness did not check the cables, but accepted Farrer's word. A verdict of "Accidental death" was returned, and the Coroner expressed the opinion that Farrer had made a mistake.

Whilst following his employment as a colliery mechanic at Lord Ellesmere's No. 2 Mosley Common Pit, near Walkden, on June 3rd, Thomas Crook (35) was killed. He was seen to open a switchbox, although he had been warned not long before not to go near it, and had no business with it whatever. A lad named John Ivill, on going to him shortly afterwards, could get no reply from him, and he was found to be dead. The current was shut off, and the body removed.

Electric Vehicles for Invalids.—Mr. Granville Bradshaw, of A.B.C. Motors, Ltd., Walton-on-Thames, who was responsible for the A.B.C. aircraft engine, &c., has designed an electrical vehicle for the use of invalids. The machine, which has already undergone preliminary tests, consists practically of a motor-cycle side-car body on four wheels. A single electric motor drives the rear axle by chain, and a battery is carried having capacity for a distance of 35 miles on one charge. It is stated that simplicity is the keynote of the machine, which is so arranged that it can be controlled either entirely by hand or entirely by foot, or by any suitable compromise between these two methods.

Power Without Fuel.—According to a statement communicated to the International Press Service by Mr. Tom Emery, within a few weeks the public will see his invention in operation; it is described as an automatic, self-starting, self-stopping motor, which generates power without fuel "by an application of hitherto unexplored principles of mechanics." It is going to put the thermal engine out of commission, he says, and can drive anything from a watch to a super-Dreadnought. Strange to say, when the inventor advertised inviting applications for licences to manufacture his motors, only a few replies were received; so he has transferred all his rights to a limited company. The use of fuel being abolished, the cost of living is to be enormously reduced, the atmosphere of cities will be purified, the population will be diffused, and the National Debt will cease to be a burden. With wages high and working hours low, Bolshevism will be struck a mortal blow. There is nothing new under the sun, said the Preacher, and this epoch-making device is a familiar phenomenon to us. That Mr. Emery is an inventor is not open to question; and his description of the Emery motor is strictly accurate, in one respect. He says it is self-stopping.

Birmingham Electric Supply Department.—WAR MEMORIAL.—The employés of the Birmingham Electric Supply Department have subscribed for and erected a memorial to their 31 colleagues who gave their lives in the war. It takes the form of a bronze tablet placed in the entrance hall to the offices in Dale End. It is a very artistic production. Surmounted by the City Arms, worked in enamel, it bears the following inscription on its centre panel:—

"This tablet was erected by the employés of this Department to perpetuate the glorious memory of their Colleagues who fell in the great war, 1914-1919."

Two side panels give a record of the names of the 31 employés who made the supreme sacrifice. Last Saturday afternoon, in the presence of a company representative of all sections of the department, the memorial tablet was unveiled by Mr. R. A. Chattock, the city electrical engineer. As befitted the occasion, which coincided with the fourth anniversary of Kitchener's death, the ceremony was a simple one, not unmingled with touches of emotion. After the unveiling, a few words from Mr. Councillor Beale, chairman of the Electric Supply Committee, and Mr. Jennings, secretary, brought the proceedings to a close. It has been arranged for photographic copies of the memorial to be sent to the relatives of the men whose names it bears.

Accident.—At the Oldham Corporation electricity works, last week, William Humphries, turbine driver, somehow touched one of the isolator switches and received a shock at 6,000 volts. He was rendered unconscious, but artificial respiration was resorted to, and after an hour-and-a-half the man was brought round. In a few hours Humphries had fully recovered his faculties. In such cases artificial respiration should be continued, if necessary, for three hours.

The Gas Regulation Bill.—*The Board of Trade Journal* gives a résumé of the objects of this measure.

It is proposed to provide:—

1. That charges for gas shall be based upon the number of heat units supplied to the consumer instead of upon the number of cubic feet of gas supplied as at present.

2. For the necessary adjustment of standard and maximum prices and sliding scale provisions, and for an addition to the price to compensate for the increased cost of production and supply of gas.

3. For the more efficient testing of the gas; and

4. For facilities for the obtaining by gas undertakers of further powers without direct recourse to Parliament.

In effect, the Bill is one for the reconstruction of the gas industry and the adjustment of the statutory obligations imposed upon the industry with regard to the quality and price of gas in the light of modern requirements. The Fuel Research Board in a report dated January 29th, 1919 (Cmd. 108), recommended as a central principle that the existing system of charging the consumer for the volume of gas of a certain nominal illuminating or calorific value which passes through his meter, should be replaced by one in which he is charged directly for the potential thermal units he receives. The alteration in the system of charging necessitates a more efficient system of testing the gas, and the Bill, while allowing gas undertakers to supply gas of any calorific value, which they declare that they propose to supply, makes provision for the extension of the functions of the gas referees and of the chief gas examiner, which are at present confined to London, to the whole country, so that testing everywhere will in future be carried out according to their directions. It is proposed in Clause I to give the Board of Trade power to make departmental orders under which effect will be given to the principles of the Bill in accordance with the conditions of the individual undertakings.

The second clause contains the statutory requirements with which undertakers, who have obtained orders from the Board of Trade, will have to comply with regard to the composition and pressure of the gas supplied by them. Power is taken if necessary to impose a limitation on the proportion of inert constituents of the gas, but an important protection of the consumer against an excessive proportion of such constituents will lie in the fact that under the new system of charging by heat value he will not have to pay for them.

A restriction on the proportion of carbon monoxide in the gas has been advocated in the interests of public health by the Fuel Economy Committee of the British Association. The Bill places an obligation on the Board of Trade to cause an inquiry to be held into this question, and if as a result of the inquiry any such restriction is found to be desirable the Board will be authorised to make a special order relating to the matter.

It is intended under the Bill that the additional costs of production and supply shall be allowed for with a view to enabling undertakings as a general rule to earn approximately their pre-war rate of profit.

The costs of administering the Act are proposed to be met by the formation of a gas fund for which a levy not exceeding £15 for each 100,000,000 cu. ft. of gas is to be made; that is to say, not more than one penny for every 14,000 cu. ft. of gas. Undertakings making less than 100,000,000 cu. ft. in the year will not be required to contribute.

Concrete Pipe Manufacture.—The May *Journal* of the S.A. Institution of Electrical Engineers contains a paper upon the manufacture of concrete pipes by the Hume centrifugal process (Hume Pipe Co. (S.A.), Ltd.). The materials employed are crushed stone from the mines in the Witwatersrand area, cement from the Pretoria Portland Cement Co., and, for reinforcement, discarded winding ropes, of which large quantities are available. The ropes are cut into suitable lengths, annealed, and then unstranded. They are then woven into cages which are placed in the pipe moulds. The latter are made of light galvanised steel sheet with cast-iron end rings, which serve a treble purpose, securing the steel casing, forming the thickness of the pipe, and providing the running treads which come into contact with the revolving disks of the moulding machine. These machines are of simple design operated by variable speed motors or long cone pulleys. The moulds are placed on the machine and rotated slowly. The concrete is thrown into the moulds until the required amount is furnished, the machine is gradually speeded up, and the centrifugal force causes the material to be evenly distributed throughout the length of the moulds; water is also driven out by this method. If an exceptionally smooth internal surface is desired, a polishing bar of steel pipe is firmly applied to the surface of the concrete. The lengths of the pipes are usually as follows: Up to 15 in. diameter, 6 ft., and from 18 to 72 in. in diameter, 8 ft. Six 4 or 6-in. diameter pipes can be completed in eight or nine minutes, and four 15 or 18-in. pipes in fifteen minutes. Larger sizes up to 60 in. diameter can be finished in about twenty minutes. The joints are made by slipping a collar of the same material over the pipes, and packing with a sand and cement mixture for low pressures or a special plastic mixture for high pressures. Sizes up to 9 in. diameter will withstand a working pressure of from 300 to 350 lb. per sq. in., while larger sizes have been tested up to 210 lb. per sq. in.

Industrial League Convention.—The Industrial League and Council is organising a convention of employers and employed to be held on Tuesday and Wednesday next, 15th and 16th inst., in Manchester. We understand that the Manchester Engineering Council is cordially co-operating with the representatives of the League in the district in making the necessary arrangements. The Conference will be held in the Town Hall.

Registration of Engineers.—The May issue of the *Journal of the Engineering Institute of Canada* gives the texts of the professional engineering Acts that have become law in British Columbia and Manitoba to incorporate the associations of professional engineers. In New Brunswick and Nova Scotia it is expected that during the present sessions of the Legislative Assembly other Acts will have been passed, and the Alberta Act has been passed recently. In Quebec there has been established the Corporation of Professional Engineers. In Ontario the formulation of an acceptable Bill is in the hands of an Advisory Conference Committee established by the suggestion of the Ontario Provincial Division. In Saskatchewan changes were suggested by the Premier which caused the Bill to be withdrawn. In the Bills that have become law "professional engineer" means any person registered as a professional engineer under the provisions of the Act; "professional engineering" or "the practice of a professional engineer" embraces the designing, supervision, the advising on the design, or supervision and the advising on the making of measurements for the construction, enlargement, alteration, improvement, maintenance, or valuation of public or private utilities, industrial work, railways, bridges, tunnels, highways, roads, canals, harbour works, harbours, river improvements, lighthouses, wet docks, dry docks, floating docks, dredges, cranes, and other similar work, steam engines, turbines, pumps, internal combustion engines, and other similar mechanical structures, airships and aeroplanes, electrical machinery and apparatus, chemical and metallurgical machinery, and works for the development, transmission, or application of power, mining operations, and apparatus for carrying out such operations, municipal works, irrigation works, water works, water purification plants, sewerage works, sewage disposal works, drainage works, incinerators, hydraulic works, and all other engineering works. The execution by a contractor or his assistants of work designed by a professional engineer, or the direction of work as otherwise defined in this clause by superintendent of construction, or superintendent of maintenance, or their subordinates when working from designs or upon advice of a professional engineer, shall not be deemed to be the practice of professional engineering within the meaning of this Act.

In the U.S.A. a committee has reported to the Society of Civil Engineers on the advisability of legislation providing for the registration of licensing of practitioners of professional engineering, architecture, and land surveying, and has recommended a uniform registration law. The report states that in fixing the qualifications for registration these were purposely made high, but they have not been made unnecessarily difficult for reasonably competent men to meet. It is not intended that candidates would ordinarily be subjected to written examinations, but rather that the board of registration would pass upon the sufficiency of the professional record of each candidate. Minimum qualifications have been provided. In order to enable the board to pass upon candidates fairly certain qualifications are specified, as, *prima facie*, evidence of fitness, which (unless other facts derogatory to a candidate are also in evidence) will permit the board to pass the candidate. The principal qualifications are; Long continued practice, graduation from a technical school of approved standing, with subsequent years of practice or membership in high-grade technical societies, in the absence of disqualifying facts.

Electrical Pumping in the U.S.A.—During the winter and spring of 1918-19, according to the *Engineering World*, 27 of the 206 public water works systems in Indiana were visited by members of the engineering experiment station staff of Purdue University, with a view to ascertaining the present status of electrical operation of such plant. Among the conclusions given are: (3) The energy consumption in properly designed plant may be expected to vary from 0.2 to 2.0 KW.-hours per 1,000 gal. per 100 ft. head, with 1.0 as a fair average. (4) The operating expenses for an electrically operated plant are low—considerably below those for a steam plant and appreciably below those for an internal combustion engine plant. —*Technical Review.*

U.S.A. National Electrical Code Revision.—The National Electrical Code was first promulgated 23 years ago, and has grown until to-day its rules are not much short of absolute law. The committee that revises the code includes representatives of the National Electric Light Association, American Institute of Electrical Engineers, American Electric Railway Association, National Electric Contractors' Association, U.S.A. Bureau of Standards, besides representatives of national and municipal bodies interested in fire prevention and underwriters' organisations. In March last, at New York City, the Electrical Committee of the National Fire Prevention Association held a public meeting on the recommended changes in the code. After the public hearing the committee held a closed meeting, at which the recommended changes were adopted with some few exceptions.

INSTITUTION NOTES.

South African Institution of Engineers.—The May *Journal* gives further and more complete details of the scheme for providing a meeting place for the South African technical and scientific institutions and societies. The Institution will be known as the "Associated Scientific and Technical Societies of South Africa." The Institute of Engineers is contributing £500 from its funds, and the members are endeavouring to raise at least another £2,000 towards the cost of the scheme. The purchase of the Johannesburg Club will cost £22,500, and the Chamber of Mines has agreed to contribute 10s. for every £1 subscribed up to a total of £5,000, and also to meet interest charges on mortgages for the first two years.

South African Association of Municipal Electrical Engineers.—According to *Engineering in South Africa*, the Annual Convention will be held this year during the week September 13th to 18th at Pretoria, where Mr. T. C. Wolley-Dod, town electrical engineer, will act as President. Provisional promises for papers have been received from Mr. A. E. Val Davies, of Cape Town, Mr. Mordy Lambe, of East London, and Mr. G. Mercier, of Bethel.

Since the last Convention, says our contemporary, the Association has suffered the loss of a number of prominent members, amongst whom may be mentioned Col. Dobson, D.S.O., Johannesburg (Past President), Mr. D. A. Stewart, Bloemfontein (Member of Council), Mr. W. Bellad Ellis, Queenstown (Member of Council), and Mr. E. T. Price, Johannesburg (Member of Council), and their places will be hard to fill.

"Most of these past members are making the change from municipal to commercial life, and it would appear that the municipalities to-day have not a sufficient appreciation of the opportunities offering to technical men of initiative and experience, or else on the other hand, there must be a feeling that the restrictions and vexations of municipal work put too great a curb on their energies and ambition."

S.A. Institute of Electrical Engineers.—In the course of a discussion, on April 22nd, on the use of electricity in developing the resources of the Union, Mr. J. W. Kirkland, past president, referring to the use of electricity in connection with agriculture, said that he believed that the time of the dark farm, when the farmer and his wife got up in the dark of the morning to milk their cows, and went to bed by candle light, had passed, and that electricity was going to change farming into a more normal kind of life. It could only be done by electricity. The farming population would increase their happiness and increase the output of the farms by electricity; having learned the advantages of electricity by reason of the electric light, they would then find the other advantages of using electric power.

Mr. C. J. M. Constancon said that before the war a director of a large German electrical manufacturing firm told him that in Germany agricultural progress was principally due to the adoption of modern and scientific methods, and that electricity had made in this direction a great stride forward. He pointed out that one of their big items of manufacture came under the heading of electrical material for agriculture, such as motors, high-tension sets for electroculture, and special types of tractor sets. He also said that for certain types of cultivation, electricity had been extensively employed; that meant that bad soil had been greatly improved. Another great factor which showed in what measure electricity was used for agriculture, was the great system of generating stations which had been erected all over the country, and was known as the overland centrals. Mr. Constancon had also visited one of the large estates in Silesia, and was surprised to see what they were doing by means of electricity. Electrical ploughing was going on night and day, and most of the work, such as the milking of the cows, the pumping, milling, cutting, and pressing was all done by electricity. There was a great future for electricity in connection with agriculture, and especially for those farms which were near large generating stations.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Captain H. L. DIXON, late R.A.F., has resigned his position as chief engineer and manager to the Leatherhead & District Electricity Co., Ltd., held since 1906, to take up private work.

Watford U.D.C. has granted the following increases of salary: Chief electrical engineer, from £650 to £800; chief assistant and station superintendent (Mr. C. E. GREENHALGH), from £384 to £608 10s. (graded as power station superintendent); mains superintendent (Mr. J. E. Wallers), from £342 to £538.

Mr. A. S. HOOPPELL, late junior assistant engineer at the Southend-on-Sea Corporation power station, has been appointed a charge engineer at the Torquay Corporation works.

Mr. L. OSTICK, mains assistant at the Bridlington electricity works, has been appointed to a similar position with the Finchley Council.

Dover T.C. has appointed Mr. E. L. SHOESMITH charge engineer, at a salary of £200 a year, to be reviewed at the end of three months.

Mr. R. L. HORSFIELD, manager of the Walsall Corporation Tramways, who is leaving for a similar appointment at Cardiff, has been presented by the staff with an inscribed oak bureau bookcase.

The salary of Mr. WISHART, electrical engineer at Motherwell, is to be increased by £100 to £550 per annum. The A.M.E.E. requested the payment of £773, with £60 bonus, plus 30 per cent.

The American Academy of Arts and Sciences has awarded the Rumford Premium to Dr. IRVING LANGMUIR, for his researches in thermionic and allied phenomena.

The Willard Gibbs medal has been presented to Dr. F. G. COTTRELL, director of the U.S. Bureau of Mines, by the Chicago Section of the American Chemical Society in recognition of his researches on the precipitation of fumes and dust.

Bath City Council has increased the salary of Mr. F. TEAGUE, the City Electrical Engineer, from £700 to £850 per annum.

The Birthday Honours List.—In the list of Birthday Honours, which was published on Saturday last, the following gentlemen are awarded the honour of knighthood:—

Mr. Philip Dawson, for service rendered as a member of the Disposal Board, Ministry of Munitions.

Mr. William Noble, chief engineer to the General Post Office.

Professor J. B. Henderson, D.Sc., Professor of Applied Mechanics, R.N. College, Greenwich.

The ELECTRICAL REVIEW tenders its congratulations to these three gentlemen.

Obituary.—MR. O. V. THOMAS.—We regret to read in the *Times* of the death which occurred on May 30th, at Marseilles, from pneumonia, of Mr. Orlo Venning Thomas, Municipal electrical engineer, Penang, late P.W.D., Straits Settlements, age 51.

PROF. AUGUSTO RIGHI.—The *Times* correspondent at Milan reports that Prof. Augusto Righi, who held the Chair of Physics at Bologna University and was well known for his experiments in magnetism and electricity and light, died at Bologna on Tuesday at the age of 70 years.

NEW COMPANIES REGISTERED.

W. Canning & Co., Ltd. (167,927).—Public company. Registered June 1st. Capital, £450,000 in £1 shares. The objects are: To carry on the business of manufacturers of and dealers in polishing and plating plant, machinery, apparatus, and materials and preparations for the businesses of electro platers, polishers, electro depositors, enamellers, and lacquerers, metallurgical chemists and analysts, drysalters, electrical and general engineers, &c., and to adopt an agreement with E. R. Canning. The first directors are: E. R. Canning, Grey House, Hamstead Hall Road, Handsworth, Birmingham; T. R. Canning, The Tan House, Lapworth, Warwick; A. B. Canning, 5, Park Avenue, Handsworth, Birmingham; E. Williams, Benson Works, Foundry Lane, Birmingham; G. A. Pope, Southam Road, Hall Green, Birmingham. Solicitor: E. P. Beale, 12, Newhall Street, Birmingham. Registered office: 137, Great Hampton Street, Birmingham.

Vickers-British East Africa, Ltd. (188,013).—Private company. Registered June 4th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in steel, iron, brass, and metals, shipbuilders, shipwrights, ordnance manufacturers, electricians, &c. The first directors are: Sir Francis Barker, Lowndes House, Lowndes Square, S.W.; S. V. Dardier, 48, Grange Road, Ealing, W.; N. Robinson, Westmoor, Green House, Slough (all of various other companies). Solicitors: Linklater and Paines, 2, Bond Court, Walbrook, E.C. Registered office: Vickers House, Broadway, Westminster.

Uno Co., Ltd. (167,790).—Private company. Registered May 27th. Capital, £5,000 in £1 shares. To carry on the business of electrical and general engineers, manufacturers of the "Uno" roaster, &c. The first directors are: P. B. Benkert, 150, Venner Road, Sydenham, S.E.; W. Bennett, 28, Amhurst Park, Stamford Hill, N.; C. P. Bennett, 28, Amhurst Park, Stamford Hill, N. Solicitor: W. N. Wyles, 4, Walbrook, E.C. Registered office: 90, Minories, Tower Hill, E.1.

Hays, Standen & Co., Ltd. (167,869).—Registered May 31st. Capital, £50,000 in £1 shares. To take over the business of engineers, merchants and manufacturers carried on at 71, Southwark Street, S.E., as "Hays, Hunter & Standen, Ltd.," and to carry on the same and the business of dealers in machinery and plant, castings for electrical, motor, and allied industries, switches, lamp holders, &c. The first directors are: J. D. Garrett, 88, Ebury Street, S.W.; P. J. Hays, Bleangate, Purley, Surrey; H. W. Standen, Canterbury House, Sevenoaks. Solicitor: T. W. Hall, 61, West Smithfield, E.C. Registered office: 71, Southwark Street, S.E.

City Electric Welding Co. (Newcastle), Ltd. (167,863).—Private company. Registered May 31st. Capital, £5,000 in £1 shares. To carry on the business of electric and oxy-acetylene welders, automobile engineers, agents for motor lorries, cars, cycles, scooters, and motor and aeroplane accessories, marine engineers, ship builders and repairers, &c. The first directors are: A. Atkinson, 1, Lesbury Road, Newcastle-on-Tyne; W. C. Waller, Elderhurst, Granville Road, Newcastle-on-Tyne; C. Deuchar, Overdale, Lindisfarne Road, Newcastle-on-Tyne. Secretary: W. C. Waller. Registered office: 2 and 4, Stephen Street, Bridge End, Byker, Newcastle-on-Tyne.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Crampton & Co., Ltd. (109,328).—Capital, £2,500 in £1 shares. Return dated April 8th, 1920. All shares taken up and paid for in full. Mortgages and charges nil.

Lymington Electric Light & Power Co., Ltd. (57,985).—Capital, £30,000 in £5 shares (4,600 ordinary and 1,400 preferred). Return dated March 31st, 1920. 3,588 ordinary and 1,285 preferred shares taken up. £24,375 paid, including £10 on shares forfeited. Mortgages and charges, £9,000.

Crossley Bros., Ltd. (51,970).—Return dated May 9th, 1920. Capital, £2,000,000 in £1 shares (403,390 preferred, 1,015,414 ordinary, and 581,196 unissued). All preferred and ordinary shares taken up. £533,200 paid. £885,604 considered as paid. Mortgages and charges, nil.

Chas W. Webber, Ltd.—Debentures dated May 17th, 1920, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: F. E. Dove, Chandos Lodge, Weston-super-Mare.

British Union Lamp Works, Ltd.—Particulars of £20,000 debentures authorised May 20th, 1920; whole amount issued. Property charged: The company's undertaking and property, present and future, including uncalled capital, subject to £10,000 first mortgage debentures. No trustees.

Sutton-in-Ashfield Motor & Electrical Engineering Co., Ltd.—Debentures charged on certain land and premises in Sutton-in-Ashfield, and the company's undertaking and property, present and future, including uncalled capital, dated May 14th, 1920 to secure all moneys due or to become due from the company to London County Westminster and Parr's Bank, Ltd.

Lighting & General Traders, Ltd.—Satisfaction in full on April 14th, 1920, of debentures dated November 6th, 1919, securing £682 10s.

Whitchurch & Pangbourne Electric Supply Co., Ltd.—Satisfaction in full on April 29th, 1920, of charge dated August 14th, 1919, securing £300.

CITY NOTES.

United River Plate Telephone Co., Ltd.

The gross earnings for the year 1919 were £976,168, and the gross maintenance and other charges in Argentina and London were £764,076, leaving £212,092, from which debenture interest and preference dividend are deducted; 8 per cent., free of tax, is paid on the ordinary shares; £50,000 is put to reserve; £10,000 to reserve (war contingencies) fund; £35,700 is carried forward, as against £36,707 brought in. The directors have sanctioned the introduction into Buenos Aires of the automatic system. The shareholders are to be asked to authorise the increase of the capital to £2,500,000, with power to the directors to issue new shares at such times and upon such terms and conditions as they shall determine, as the general expansion of the undertaking of the company and the necessity of coping with the ever-increasing demand for new telephone facilities entail an outlay which can only be met by the provision of additional capital.

Callender's Cable and Construction Co., Ltd.

The report for 1919 shows a balance to the credit of profit and loss account of £161,525. Debenture interest absorbs £13,500; preference dividend £26,000; depreciation of buildings, plant, and machinery £37,500; depreciation of office furniture £500. The balance brought forward was £114,779, and the available balance is £198,803; 15 per cent., less income tax, on the ordinary shares requires £60,000; there is put to special reserve for war taxation £33,000, and carried forward £105,803. During the year an entire change has taken place in the business of the company, as the factories both at Erith and of the Anchor Co. at Leigh, have been converted from manufacturing war materials to ordinary commercial production. This conversion has involved much work, and has taken considerable time. During that period output was seriously interfered with, but the change-over is now complete, with most satisfactory results. The urgent necessity to increase the company's production, notwithstanding the working week being reduced to 47 hours, required a reorganisation of the factory conditions, and, after lengthy negotiation, a system of continuous working by three rotary shifts was established, with the result that output has now been substantially increased. In the early part of the year it became evident to the directors that additional plant and machinery were required to meet the increasing demands of the industry for cables capable of working at much higher voltages than in the past. Extensive new workshops were therefore erected for the manufacture of super tension mains of 33,000 volts and upwards, and these are now practically completed. The Picardy works, which were specially erected and equipped with machinery for the rapid manufacture of field telephone cables for the army, have been completely converted and re-equipped with plant for the manufacture of telephone cables for general use. The financial results of 1919 are regarded as eminently satisfactory, especially when consideration is given to the difficulties inseparable from the great change-over which has occurred, and the general reorganisation of industry. They believe that the full results of the new plant will only be apparent in the future, and, seeing that the volume of orders obtained is exceptionally large, they have every hope that the financial results of the current year will be even more favourable. The business of the Anchor Cable Co., Ltd., a subsidiary of this company, suffered from the process of conversion referred to above, but, nevertheless, the financial results have been satisfactory. An excellent feeling prevails between the operatives and the management. As the financial resources of the company, even with the additional capital issued in 1918, have not sufficiently met the requirements of the company's increasing trade, the directors, early in April last, took the necessary steps to increase the capital by the creation of 400,000 "B" cumulative preference shares of £1 each; these will be issued shortly and, with them, the unissued balance of 100,000 ordinary shares.

Marconi International Marine Communication Co., Ltd.

The report for 1919 states that the business continues to show substantial expansion. Gross revenue £772,019, an increase of £208,813 over 1918. This increase is in part due to an advance in ship subsidies in consequence of a large advance in salaries of telegraphists during the period, and it is counter-balanced to a considerable extent by the increase in expenditure.

In consequence of unfavourable rates of exchange which obtained at the end of the year, considerable sums of money have been allowed to remain abroad on deposit or invested in foreign Government securities. A sum approximating £50,000 has been debited to profit and loss account, calculating the rate of exchange on December 31st, as though the money had been brought home at that date, and the loss incurred. The loss, however, has not been actually incurred, and when in the course of time exchanges improve, as no doubt they will do, the sums written off will figure in a future balance sheet as a profit.

Notwithstanding this temporary depreciation and the writing off of some £20,000 representing depreciation in investments in Government securities, the profit for the year shows an increase over the preceding year.

Final dividend of 10 per cent. for 1919, making 15 per cent. for the year. 748 debentures of a par value of £14,960 were redeemed. The total number of public telegraph stations owned and worked by the company on the high seas increased from 2,549 to 2,842. The organisation of the company, together with that of its associated companies, has continued to render inestimable service in the saving of life and property. The Amalgamated Wireless (Australasia), Ltd., in which this company is interested, has paid a dividend of 5 per cent. in respect of the year ended June 30th, 1919. Of the 600,000 new shares offered to shareholders, at par, on May 10th, 1919, 592,726 shares were subscribed. Lord Herschell, G.C.V.O., has been appointed a director.

Cork Electric Tramways & Lighting Co., Ltd.

The revenue for 1919 was £90,860 and the expenses were £70,734, leaving £20,127 plus £3,649 brought forward. Interest on the debentures absorbs £4,600; there is put to reserve for depreciation and renewals £6,500; to maintenance reserve, £4,000; 5 per cent. dividend on the preference shares requires £6,163, leaving £2,512 to carry forward. The revenue increased by £11,941 as compared with 1918 (of which £4,930 was from the tramways and £6,232 from lighting and power). Expenses increased by £13,349, chiefly due to higher salaries and wages and cost of coal and other materials. The gross profit shows a reduction of £1,408 as compared with 1918. An increase in fares was authorised in August, 1919, and the revenue since that date has materially improved. The increased revenue from lighting and power is mainly due to increased charges. Expenses have materially increased since the last revision of fares, and lighting and power tariffs and further adjustments of charges are now under consideration. Capital expended during the year (£13,290) was mainly for house services, cables and plant. A 2,000-KW. Curtis turbine is now in course of construction. The lease of the Lighting Order from the Cork Corporation which expired in August, 1918, has, after prolonged negotiations, been renewed for a period of 40 years; the approval of the Board of Trade is awaited.

Urban Electric Supply Co., Ltd.

Presiding at the annual meeting recently Mr. P. D. Tuckett said that last year, following on an increase of £28,000 in 1918, the higher price of coal and the rise in wages account for a further increase of £36,000, making a total increase of £120,000 since 1914 for those two items alone. They had repeatedly applied to the Board of Trade for sanction to increases in their charges to meet these increased costs, but the relief obtained had been wholly inadequate. They had hoped that the Bill which, together with Edmundsons' Electricity Corporation, they had promoted, would have given them the right to earn the reasonable return on their capital to which they were entitled and without which they could not properly discharge their statutory obligations. Whereas every other trader, including the Government, had long since met the conditions by a corresponding adjustment of price, this company was still suffering, and, indeed, all but perishing, from inability to make such adjustment. It was the only remedy open to them, and it would be a monstrous injustice if it was much longer denied them—both to shareholders and to the staff. It was with much regret that he had to report the rejection of the Bill by the Select Committee of the House of Lords. Since then they had had an interview with the Electricity Commissioners, and they appeared to be alive to the seriousness of the position and professed their anxiety to find a remedy without delay. They were unable to specify the exact form which the remedy would take. The company would leave no stone unturned to get the Commissioners' good intentions converted into definite action at the earliest possible date. No further capital would be put into the business until there was a satisfactory assurance of a reasonable return thereon; yet no business was more dependent on a steady flow of new capital, if healthy development was to continue. But for the war they would have been able to show an available balance to-day of between £50,000 and £60,000 which would have amply sufficed to provide for depreciation and for the payment of a substantial ordinary dividend. Instead, however, of their being in a position to pay an ordinary dividend, they were unable to pay any preference dividend, and were not even able to provide at all adequately for the increased depreciation which the increased cost of

plant renewals now entailed. The results were deplorable, and unless the conditions which had produced them were very shortly relaxed, it was quite obvious that the industry, so far as most of the smaller provincial undertakings were concerned, was going to be brought to a standstill. They were not only denied the right to earn a profit, but were compelled to supply at a heavy loss which it was altogether beyond their capacity to bear. So desperate were the straits to which some of the undertakings were reduced, that from sheer lack of funds it was no longer possible for them to pay their men the increased scale of wages which recent awards entitled them to claim. They had, therefore, most reluctantly been forced to adopt, as the only policy open to them, the purely retrograde one of doing everything in their power to discourage development. In the present uncertainty as to the treatment they were to receive, he hesitated to offer any advice as to the value of the shares, but it would be a pity if they were to allow the natural disappointment and discouragement of the moment to induce them lightly to throw their holdings. The enormous increase in the cost of plant and buildings had greatly enhanced the value of the property, and it was only the artificial and unfair restriction of their rates of charge that prevented it from producing a satisfactory return. Provided therefore that they were given the right to charge higher prices, which they were satisfied their consumers would readily pay, he saw no reason why they should look to the future with any less confidence than formerly. The demand promised to be greater than ever, but before they could increase their obligations they must have a reasonable expectation of earning a commercial return. Under the most favourable circumstances some little time was bound to elapse before they could make good the injury, and fully restore the position to what it should be.

German Companies.

The directors of the *A.G. Mix & Genest, of Berlin*, recommend the payment of a dividend at the rate of 7 per cent. for 1919, this contrasting with no distribution in the preceding year.

The Lloyd Dynamo Werke A.G., of Bremen, proposes to pay a dividend at the rate of 7 per cent. out of net profits of 188,000 marks in 1919, as compared with 7 per cent. and 201,000 marks respectively in the preceding year.

The accounts of the *Deutsche Kabelwerke A.G., of Berlin*, including the balance forward, and after making provision for depreciation, show net profits of 1,392,000 marks for 1919, as compared with 896,000 marks in the previous year. It is intended to pay a dividend at the rate of 10 per cent., being the same as in 1918.

The report of *Voigt & Haeffner A.G., of Frankfort-on-Main*, states that a scarcity of raw materials continued in 1919 and caused great restrictions in the production. The net profits amounted to 1,840,000 marks, as compared with 2,003,000 marks in 1918, the dividend being at the rate of 18 per cent., as in the preceding year. It is said that the prospects are not unfavourable provided that a sufficient supply of raw and semi-finished materials is available.

The report of the *Dr. Paul Meyer A.G., of Berlin*, states that the difficulties experienced in obtaining raw materials rendered it impossible fully to meet the demand in 1919, particularly in the new department for electricity meters. The net profits amounted to 675,000 marks, as against 437,000 marks, and a dividend at the rate of 10 per cent. has been declared on the increased capital of 6,000,000 marks, being the same rate as in 1918.

The Ges. fur Elektrische Unternehmungen, of Berlin, states that the tramways in which the company is interested experienced still more unfavourable results in 1919 than in the preceding year. The net profits were derived partly from the sale of foreign investments and partly from the improved results of electricity supply works, they having amounted to 5,792,000 marks, as compared with 4,485,000 marks in 1918. It is proposed to pay a dividend at the rate of 8 per cent., as against 6 per cent. in the previous year, and to devote greater attention to investments in manufacturing works in the future.

The report of the *Bergmann Elektrizitats Werke A.G., of Berlin*, whose accounts have previously been published (12 per cent. for 1919, as in the preceding year) states that an abundance of orders was received for all departments, although the irregularity in the production specially prejudiced the export trade, as it was impossible fully to execute the orders resulting from the resumption of relations. In general manufacturing was limited to the satisfying of normal commercial requirements. Numerous light and power installations and portable motors were delivered for agricultural purposes, and the railway department was chiefly occupied with the completion of heavy high-speed locomotives.

The report of the directors of *Hartmann & Braun A.G., of Frankfort-on-Main*, states that the net profits in 1919 were the lowest in the history of the company. After applying 513,000 marks to depreciation, as against 425,000 marks in 1918, the accounts show net profits of 71,000 marks, as compared with 295,000 marks. Including the balance forward and 100,000 marks transferred from the transition reserve fund, the sum available for disposal is 267,000 marks, as contrasted with 357,000 marks in the previous year. It is proposed to pay a dividend of 6 per cent., as compared with 9 per cent. and 15 per cent. in the two preceding years respectively. As to the cause of the less satisfactory results last year, it was stated at the recent general meeting to be extremely difficult to calculate prime costs and sale prices in times of economic fluctuations, whilst if the coal supply became further reduced the worst apprehensions would be justified. It was also necessary to take into consideration the reserve manifested in the general business, and they would have to be prepared for still further reserve and extensive cancellations of orders.

Havana Electric Railway, Light & Power Co.—For 1919 the gross earnings totalled $9,397,452. Operating expenses and taxes $4,979,685, leaving net income $4,417,767. Net profits from operation and miscellaneous income $3,502,594, out of which has been set aside as reserve for depreciation $622,121, leaving $2,880,473, plus $2,639,025 brought forward, making together $5,519,498, from which has been deducted amortisation of bond discount and expenses $24,250, provision for sinking fund in respect to English bonds of Compania de Gas y Electricidad de la Habana $13,533, provision for sinking fund in respect of consolidated mortgage bonds of Havana Electric Railway $114,870, provision for sinking fund in respect to general mortgage bonds of Havana Electric Railway, Light & Power, $52,728, dividends paid during year (6 per cent. on preferred and common) $2,155,612, leaving to be carried forward $3,158,503.

A Swiss Investment Co.—The directors of the Motor A.G. fur Angewandte Elektrizitat, of Baden, Switzerland, which is a holding company connected with the Brown-Boveri group, state that the undertakings in which the company is interested developed favourably in 1919. The net profits amount to 2,150,000 fr., as compared with 2,271,000 fr. in 1918, and a dividend of 5 per cent. has been declared, as against 7 per cent. A loss of 3,604,000 fr. in exchange is recorded on foreign investments and credits, and has been placed to an exchange account to be redeemed.

Great Northern Telegraph Co., Ltd.—The directors propose for 1919 the distribution of a total dividend and bonus of 22 per cent., including the 5 per cent. already paid, and to transfer £61,111 to the reserve and renewal fund and £55,556 to the renewal fund for cable steamers; £41,667 has been allotted to the pension fund. It is further proposed to set aside £305,556 for extraordinary taxes, and to carry forward £141,607 to 1920.

Siemens Brothers & Co., Ltd.—The annual meeting was held on Tuesday. The dividend, 10 per cent. for the year, has already been mentioned here. According to the *Financial Times*, £5,000 has been placed to buildings reserve, £7,329 to pension fund and retiring allowances, £25,000 to write off from discount the sale of debenture stock, reducing the item to £37,500, £15,000 to general reserve, making £75,000, carrying £315,776 forward, subject to excess profits duty.

At the meeting, Mr. G. Mure Ritchie, the chairman, delivered a very interesting speech on the progress that was taking place in all departments of the business. We shall deal with the matter in our next issue.

Public Issue.—*W. Canning & Co., Ltd.*—The *Times* states that "another industrial flotation that is to be made in the very near future is the century-old business of W. Canning and Co., the Birmingham firm of electro-plate manufacturers and dealers. The present issue is 300,000 ordinary shares of £1, of which 100,000 will be taken by the vendor as part of the purchase consideration."

Stock Exchange Notices.—Application has been made to the Committee to allow the undermentioned to be officially quoted:—

London Electric Wire Co. & Smiths, Ltd.—400,000 7½ per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 400,000).

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers has amounted to: Four weeks ended February 27th, 1920, 2,342,360; 1919, 2,009,647. Four weeks ended March 26th, 1920, 2,624,680; 1919, 2,379,613. Five weeks ended April 30th, 1920, 3,764,065; 1919, 3,283,030.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Interim dividend of 3 per cent., less tax, on the 6 per cent. cumulative preference shares for half-year ending June 30th.

Calcutta Tramways Co., Ltd.—Final dividend of 6s. 6d. per share, free of tax, making 10 per cent. for 1919 on the ordinary shares.

Greenwood & Batley, Ltd.—Net profits for year ended March, 1920, £60,044, plus £14,422 brought forward. Total dividend for the year on the ordinary shares 15 per cent.; £6,000 to depreciation; £10,000 to contingencies; £25,308 carried forward. £174,195 of reserve has been capitalised, and share for share distributed. As a result of revaluation of the works £150,000 appreciation on book value has been added to reserve.

British Electric Traction Co., Ltd.—Dividend of 4 per cent. on the ordinary stock for year ended March, 1920, carrying forward £150,000.

STOCKS AND SHARES.

TUESDAY EVENING.

THE dropping of the idea of a War Wealth Levy had less effect in the Stock Exchange than it might have done had it not been for the fears of dearer money which make themselves felt amongst all the investment markets. Nor is the anxiety confined to investment markets only, inasmuch as the possibilities of an 8 per cent. Bank Rate weigh also upon enterprise as it concerns more speculative operations, and checks business generally. There are those in the City who scoff at the idea of an 8 per cent. rate on this side of September, but the Bank and Treasury have given too recent evidence of their capacity for springing surprises on the monied community for a great deal of certainty to be felt in regard to Bank Rate stability at present. This, in fact, is the predominant influence in markets at the moment, and naturally it has a depressing influence.

The Home Railway market is troubled again by another batch of demands from the railwaymen. As the eel gets accustomed to skinning, so the market for these stocks is by now familiar with the persistent rise in expenses. Therefore prices are not flat. They are simply heavy. Underground Electric Incomes at 58½ are 2 points down, but the shilling shares came into some little request, and moved up to 5s. Districts are lower at 15. Metropolitans have been left unchanged at 19½. It may be worth mentioning that Metropolitan 3½ per cent. debenture can be bought at 57½, with an interest payment due in July, and the yield at this price is 6¼ per cent. on the money. London Electric 4 per cent. preference at 50½ pays practically 8 per cent., and District 4½ per cent. preference is on offer at 56, paying 8½ per cent. In spite of the demand that there is for a good many Home Railway prior-charge stocks, these Underground descriptions are somewhat out of favour, though for the longer shot some people regard them as worth picking up at current quotations in order to mix with securities that return less on the money.

Amongst foreign traction varieties, the principal feature is the strength of Anglo-Argentine Tramways 1st preference. The price touched 3¼ before coming back to 3½, the latter showing a rise of 5s. on the week. This is due to the directors' announcement that the company will pay off one year's arrears of dividend to the middle of 1918, leaving two years more, which in money is equal to 11s. per share, to be met later on. This resumption of dividends will have been expected for some time past by those who have followed this column. The company's 5 per cent. debenture stock gained 3½ at 59½, and the second preferences at 3½ are the fraction to the good. Brazil Tractions lost 2 points of their last week's jump, and in Mexicans there is nothing fresh to report. A rise of 2 in British Columbia Electric preference advanced the price to 57½. The various dollar securities are a little better on the week, but the rises are mostly confined to a point or so apiece, and no dramatic change has taken place throughout the list. Canadian General Electric preference at 109½ are 2 higher.

Cable companies' stocks exhibit a tendency to sympathise with dulness elsewhere. Eastern ordinary is 3 lower, and Westerns have shed 5s. The various recent issues in this group are somewhat lower, except Western Telegraph new at 3¾ premium for the £1 paid shares. Eastern Extension new are 3 to 3¼ premium, and Globe new 3¼-3¾ premium, both £1 paid. The Eastern Telegraph shares, 2s. paid, have been 9s., but eased off to 7s. 6d. There is no rally from the slump in Indo-Europeans which occurred last week. United River Plate Telephones are to receive their usual dividend of 5 per cent., making 8 per cent. for the year, tax free. It is proposed to increase the capital by half-a-million pounds to 2½ millions, though not to make an immediate issue. The shares are of the nominal value of £5, and as the ordinary are quoted at 7½, there is a hint here of a possible bonus presently.

Active business is in progress in the Marconi group, and the shares of the parent company touched 3½ before there was a slight reaction. The price has come up steadily from 2¾ to the present level of 3 7/16. As already stated here, the support is declared in the market to have come from Italian sources, it being said that certain Italian holders who had sold Marconis heavily, are now taking them back again. The gossip is repeated for what it may be worth, but at any rate the market is in a much more healthy condition than it has been for some time past. With the rise in Marconis has come a sympathetic improvement in Marconi Marines, the price advancing to 2¾, but reacting to 2 later on. The report just out shows that the gross revenue of £772,000 is £208,000 more than that of the preceding 12 months. The dividend of 10 per cent., making 15 per cent. for the year, is the same, however, as that paid for the last three years. The capital was increased some 18 months ago by 600,000 new shares, and, of course, the dividend has to be paid on the extra money then provided. Canadian Marconis remain at half-a-guinea. No market has yet developed in Radios, and, although some of the certificates issued in exchange for the American Marconis have reached this side, the Stock Exchange Committee have not yet given their permission for dealings to take place.

There is little fresh to say with reference to electric lighting shares. It is reported that a certain number of inquiries for the cheapest shares have reached the market, but they have not materialised into buying orders, and prices all round are dull. As one jobber remarked, it is hardly to be expected that people will buy electric lighting shares when they can see to read up to nine o'clock at night. On balance, the only quotable alteration on the week is a decline of 5s. in London Electric preference.

Manufacturing shares are quiet. General Electric ordinary hardened to 32s. 6d., while Henleys at 1¾ are 2s. 6d. lower. Cromptons retained their rise at 22s., and British Insulated keep firm at 37s. Babcock & Wilcox at 2¾ show no change. A new issue of Callender's Cable shares of 100,000 ordinary and 400,000 preference is announced. Underwriters were offered one new ordinary at 24s., in company with four new "B" preference at £1. The old ordinary stand about 30s. in the market, and the 6½ per cent. preference at 18s. 9d. Net profit for the year amounts to £161,500, and a 15 per cent. dividend is declared. Armament shares show a tendency to decline, Armstrongs and Vickers both leaning to the heavy side. The rubber market is steady, with the raw material close to a florin per lb. The public are taking little interest in rubber shares at the present time, and the same remark may be extended, indeed, to many of the other industrial sections which make up the Miscellaneous Market of the Stock Exchange.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price June 8, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	62	—	£9 8 2
Charing Cross Ordinary	4	7	92	—	9 6 8
do. do. do 4½ Pref.	4½	4½	92	—	8 3 8
Chelsea	3	4	92	—	8 0 0
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/-	—	7 1 2
County of London	7	8	84	—	9 17 0
do do. 6 per cent. Pref.	6	6	84	—	7 6 5
Kensington Ordinary	6	7	44	—	7 15 6
London Electric	Nil	2½	1½	—	8 0 0
do. do. 6 per cent. Pref.	6	6	8	— ¼	10 0 0
Metropolitan	5	6	27	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	51½	—	8 0 0
St. James' and Pall Mall	10	12	62	—	8 16 10
South London	5	6	24	—	9 13 0
South Metropolitan Pref.	7	7	18/0	—	7 0 0
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	77½	—	7 14 10
do. Def.	23/6	1½	18	— ¼	8 6 8
Chile Telephone	5	6	6½	—	*4 12 2
Cuba Sub. Ord.	7	7	24	—	*27 7 4
Eastern Extension	8	10	15	—	*8 13 4
Eastern Tel. Ord.	8	10	150½	—3	*8 19 0
Globe Tel. and T. Ord.	8	10	154	—	*8 7 0
do. do. Pref.	6	8	84	—	7 1 2
Great Northern Tel.	22	—	214	—	9 15 6
Indo-European	18	10	95	—	7 2 10
Marconi	25	—	3 7/16	+ ⅛	7 5 6
Oriental Telephone Ord.	10	12	24	—	*4 16 0
United R. Plate Tel.	8	8	74	—	*5 6 8
West India and Panama	1/8	Nil	⅞	—	Nil
Western Telegraph	8	10	15½	— ½	*8 9 0
HOME RAILS.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	19½	—	6 8 2
do. District	Nil	Nil	15	— ½	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5/-	+1/-	Nil
do. do. Income	5	4	58½	—2	6 16 9
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	34	—	7 17 2
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	89½	+3½	8 8 0
Brazil Tractions	—	—	51	—2	—
Bombay Electric Pref.	6	6	134	—	4 11 3
British Columbia Elec. Ry. Pfce.	5	5	57¼	+2	8 13 10
do. do. Preferrred	24	5	48½	—	10 6 2
do. do. Deferred	Nil	3	45¼	—	6 11 10
do. do. Deb.	4½	4½	52½	—	8 2 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	28¾	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20½	—	Nil
Mexican Light Common	Nil	Nil	12¾	—	Nil
do. Pref.	Nil	Nil	21¼	—	Nil
do. 1st Bonds	Nil	Nil	43½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	27½	—	*5 4 4
British Aluminium Ord.	10	10	1 7/16	—	9 8 2
British Insulated Ord.	12½	15	1 13/16	—	8 2 8
Callenders	25	15	1½	—	8 6 8
,, 6½ Pref.	6½	6½	18/9	—	6 18 6
Castner-Kellner	20	—	4	—	5 0 0
Crompton Ord.	10	—	22/-	—	9 1 10
Edison-Swan, "A"	10	—	1 5/8	—	8 8 0
do. do. 5 per cent. Deb.	5	5	70¾	—	6 5 9
Electric Construction	10	—	21/-	—	9 10 6
Gen. Elec. Pref.	6¼	6¼	18/6	—	7 0 5
do. Ord.	10	—	32/6	+6d.	*6 3 0
Henley	25	15	1¾	— ¼	8 0 8
do. 4½ Pref.	4½	4½	9½	—	6 18 6
India-Rubber	10	—	15½	—	*7 11 0
Met.-Vickers Pref.	—	8	2 5/8	—	6 18 6
Siemens Ord.	10	10	26/-	—	*7 13 10
Telegraph Cpn.	20	20	23½	—	*5 6 8

* Dividends paid free of Income Tax.

DIRECT CURRENT COMPARED WITH 3-PHASE CURRENT FOR DRIVING STEEL WORKS PLANT.

By C. A. ABLETT, M.Inst.C.E.

(Abstract of paper read before the Iron and Steel Institute.)

The principal advantage of a three-phase system is that it enables power to be transmitted cheaply over long distances at high voltages. It has, however, the disadvantage that three-phase motors are not capable of speed variation without considerable loss of power, unless they are of a complicated and costly type, and therefore not well suited to many steelworks purposes.

Direct current does not lend itself to cheap transmission of power over long distances, but in most iron and steel works this point is not of importance. Direct-current motors are capable of speed variation over a wide range without loss of power, and this and other natural characteristics render them very suitable for many steelworks purposes.

Most of the merchant mills and bar mills in the British Isles roll a large number of different sections, of which the heavier should be rolled at low speeds and the lighter at high speeds. To get the best results and output from the mills, each section should be rolled at its own particular speed. If such a mill be driven by a D.C. motor, the speed can easily be regulated through a very wide range by a shunt regulator in the motor field without entailing any loss of power, and, as the speed of the motor is reduced, the turning moment increases, so that the maximum turning moment is available where it is required for rolling the heavy sections at slow speeds. The speed remains at about the basis speed corresponding with the setting of the shunt regulator, so that the mill does not run up to high speeds when the bar is out of the rolls.

If an ordinary three-phase motor were employed, the speed could only be reduced by inserting resistances in the rotor circuit, which would cause waste of power nearly proportional to the reduction in speed of the motor. The three-phase motor cannot give any increased turning moment at the low speeds, but on the contrary tends to lose its overload capacity as the speed is reduced, so that to obtain large turning moments at reduced speed, a large and more expensive motor must be installed. When driving a mill at reduced speed, the three-phase motor tends to run up to full speed as soon as the bar leaves the rolls, and also tends to fall greatly in speed while rolling a heavy section; so that the speed varies greatly, which means a poor tonnage from the mill.

Figs. 1 and 2, which give a comparison between the working of a 1,200-H.P. D.C. motor and a 1,200-H.P. three-phase motor driving a mill, illustrate these points.

The full speed of both is 150 R.P.M., and the speed of each motor is reduced so as to drive the mill at 115 R.P.M. A few passes only are shown in the figures, for the sake of simplicity.

Fig. 2 shows that the power lost in the three-phase motor is nearly three times as great as in the D.C. motor, and it should be pointed out that while, if the mill were driven by a three-phase motor, a 1,200-H.P. motor would be required, on the other hand, if it were driven by a D.C. motor, a smaller motor than this could be employed with a corresponding reduction in the amount of power lost.

Fig. 1 shows that the speed of the three-phase motor cannot be properly controlled, as it varies from 95.2 R.P.M. to 147 R.P.M.—a variation of 44.8 per cent.—the speed rising to 147 R.P.M. when the bar leaves the rolls. The variation in speed of the D.C. motor is 8.5 per cent., this variation being allowed to enable the flywheel to assist the motor, and this speed variation is capable of being reduced. Fig. 1 shows how greatly the output from the mill would be reduced if it were driven by a three-phase motor, owing to the impossibility of keeping the speed under control.

A number of devices have been used to overcome these inherent difficulties of the three-phase motor; while they enable speed regulations to be obtained without excessive loss of power, and some of them enable the speed to be kept reasonably under control, they usually entail the use of more than one machine, are always much more expensive in capital expenditure, are less economical, and more complicated than the plain D.C. motor.

The operation of a rolling-mill motor and flywheel must next be considered, as the majority of rolling-mills are provided with flywheels. To enable the flywheel to take a part of the power required during a pass, the motor must automatically fall in speed during the pass. This variation in speed under practical conditions—that is, with a flywheel of moderate size and without undue variation in the power taken by the motor—can easily be 10 per cent. to 15 per cent. of the motor speed.

If a D.C. motor be used to drive the mill, this automatic variation in speed can easily be arranged by providing a compound winding in the motor field, which does not entail loss of power. On the other hand, if a three-phase motor be used, the variation in speed is obtained by inserting resistances in the rotor circuit, so that, when the speed falls by 15 per cent., practically 15 per cent. of the motor power is wasted. If the speed variation is to be less than this—which is, of course, an advantage from the point of view of obtaining a greater output from the mill—either a greater variation in the motor power must be allowed or a heavier flywheel must be used; and there is not much scope in the latter direction, as the practical limit in flywheel weight is soon reached.

Devices employed for varying the speed of mill motors intermittently, such as the so-called automatic slip regulator, are too slow in action to be of value with the type of mill which is here referred to.

The foregoing remarks show that three-phase current is unsuitable for driving merchant and bar mills. Compared with direct current it is either wasteful of power, involves loss of output from the mill, or involves an unduly high capital cost. Three-phase current has, however, been extensively used in America for driving mills, but there commercial conditions are different from those prevailing in the British Isles, for the tendency in America is for large tonnages of a particular section to be rolled in one mill, so that the question of speed regulation becomes of less importance than in Great Britain, and consequently the three-phase motor is not at so great a disadvantage. In visiting American mills the author has nevertheless seen a number of cases where three-phase current has been used where better results would be obtainable with direct current.

It may be pointed out that where means are available for readily varying the speed of the mill, increased output is sometimes to be obtained by gradually increasing the speed of the mill as each billet is being rolled, so that the first passes on the billet are made at a moderate speed, and the last passes on the finished section are made at a high speed. This method of working has been developed to a considerable extent in certain large three high continental mills where very large tonnages are obtained. While the majority of mills of this description have been driven, with good results, by a motor coupled to a flywheel, there is, in the author's opinion, too great a tendency to accept the flywheel without

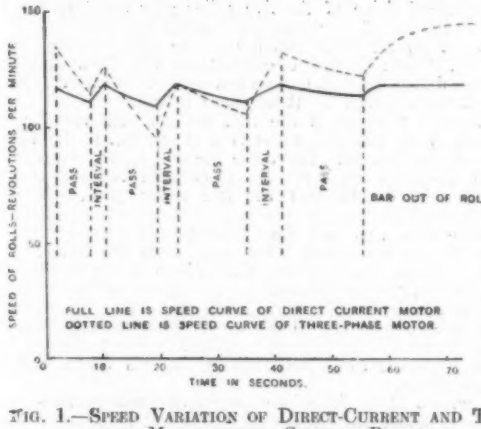


Fig. 1.—Speed Variation of Direct-Current and Three-phase Motors when Speed is Reduced.

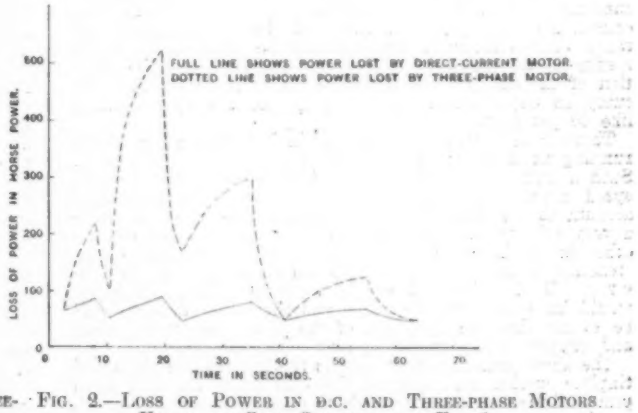


Fig. 2.—Loss of Power in D.C. and Three-phase Motors. Under the Same Conditions as Fig. 1.

Loss of Power in Three-phase Motor is 2.92 Times that of Direct Current Motor.

considering the possibility of obtaining an increased output if it were dispensed with. When a new mill is being put down, this point should receive full consideration. A rolling-mill motor should not be regarded merely as a motor to drive a rolling-mill, but, if the best results are to be obtained by electric driving, the rolling-mill plant, if new, and the mill motor should be suited to one another, and both the mill and motor be considered as a combined plant.

It should be remembered that rolling-mill plants have been developed in connection with the steam drive. The electric motor has certain different characteristics from the steam-engine, and full advantage should be taken of these differences.

The proportion of sheet and tinplate mills which are driven electrically is not so great as the proportion of merchant and bar mills, and the statement has frequently been made that it is cheaper to drive hot mills by steam than electrically. The author believes that there is a foundation for this statement, and that the reason is as follows:—

The speed of the rolls in such mills is usually from 30 to 40 R.P.M., depending on the roll diameter, and when driven by a steam-engine, the engine is generally direct coupled. Where electrical driving has been adopted, a motor running at a comparatively high speed has been used which drives the mill by ropes or by gearing. Now, the variations in the power required to drive such mills are very great indeed, perhaps greater than with any other type of mill, so that the average power consumption is only a small fraction of the maximum power.

The rope or gear drive entails a certain loss of power which is going on continuously, so that, while this loss of power may be only a small percentage of the maximum power, it still forms a very substantial addition to the average power, so that it materially increases the energy consumption measured in kilowatt-hours per ton rolled.

If a three-phase motor were installed to drive such a mill, this loss of power would be accentuated by the loss which occurred in the resistances connected in the rotor circuit, which are necessary to enable the flywheel to give up power when required, and these losses, while they may be only a small percentage of the maximum power, make a substantial addition to the average power taken, thus materially increasing the energy consumption expressed in kilowatt-hours per ton rolled. Now, in the author's opinion, if such a mill be driven by a low-speed motor running at 30 to 40 R.P.M., the running costs of the electrical drive would be found to be considerably cheaper than those of the steam-engine, for these various losses of power would be eliminated. From results in the author's possession, he considers that the adoption of the direct drive would be found to reduce the consumption expressed in kilowatt-hours per ton by something like 40 per cent.

There is no engineering difficulty in installing a D.C. motor running at a speed of 30 R.P.M. for driving a sheet mill. Such a motor would be larger and more costly than a high-speed motor, but when all the circumstances are taken into account the savings to be effected should be found to make a very substantial return on the extra capital cost. On the other hand, there are serious engineering difficulties in constructing a three-phase motor to run at a speed of, say, 30 R.P.M. If the electrical supply were 50 cycles, the motor would have to have 200 poles, and the power factor would be so low that the operation of the power generating plant and supply system would be very adversely affected.

The above remarks apply only to the hot mills in sheet and tinplate works, and not to the cold rolls, which require practically constant power to drive them at a constant speed, so that for cold-roll driving there is very little to choose between direct and alternating current.

The reversing mill is driven by a direct current motor, supplied with current from a motor-generator set coupled to a heavy flywheel.

The motor of the motor-generator set would have a normal power of about one-fifth or one-sixth of the power given by the mill motor when at work, and the question is whether it is better that this set should be driven by an A.C. or a D.C. motor. For example, a 2,000-H.P. motor may be used to drive the set, of which the flywheel at full speed would have a total stored energy of 200,000 H.P.-seconds, of which 72,000 H.P.-seconds would become available for neutralising the variations in the power.

The speed of this motor would be so varied by some form of relay connected in the circuit supplying the motor that the power in the circuit would be maintained at as nearly a steady value as possible—that is to say, that the speed of the motor would be reduced when the bar was in the rolls, so that the flywheel could supply part of the power required by the mill motor, and when the bar was out of the rolls the speed of the motor would be increased, thus increasing the stored energy of the flywheel. In some works this relay has been connected in the main power circuits of the power-house, so that the flywheel of the reversing rolling-mill equipment is not used merely to maintain the power required to drive the reversing mill at a constant value, but for a much more useful purpose—namely, to keep the power supplied by the power-house as constant as possible by providing the power required for heavy peaks of short duration, which may be caused by other parts of the plant, from the stored energy of the flywheel. This is a valuable asset, because if the power is supplied from a gas-engine station, of which the overload capacity is not very great, it may save an additional engine, and in any case the more constant the power-house load is kept, the cheaper the supply of electrical power becomes.

If the 2,000-H.P. motor driving the motor-generator set is a D.C. motor, it will not only cease to take power from the power station if a heavy peak occurs elsewhere in the works, but can act as a generator and supply electrical power drawn from the stored energy of the flywheel to help the power station. For a peak of short duration the motor thus acting as a generator can work up to double its normal capacity, and can help the power station to the extent of something approaching 6,000 H.P. for a short time. If, however, a three-phase induction motor be used to drive the motor-generator set, it cannot generate power to help the power station, but can only cease to take a considerable portion of its power from the power station. Thus the D.C. motor is about three times as effective as the three-phase motor in helping the power house to overcome peaks.

It has also been pointed out that the motor-generator set has to be made to fall in speed artificially so that the flywheel can give the surplus power required by the reversing mill motor; this fall in speed would be of the order of 20 per cent. If a D.C. motor be used to drive the motor-generator set, this fall in speed does not entail any loss of power, but if a three-phase induction motor be used, the 20 per cent. fall in speed means that a considerable proportion of the power supplied to the motor is wasted.

On the average it may be taken that 10 per cent. of the power supplied to the three-phase motor is wasted, which would increase the kilowatt-hours per ton and consequently the cost of energy for rolling by 10 per cent.

A motor-generating set driven by a three-phase alternating motor is limited to certain speeds corresponding to the synchronous speed of this motor. If the supply be 50-cycle, the synchronous speeds within the practicable range are 600, 500, 428, and 375 R.P.M. It may happen that the flywheel or the variable-voltage generators can run at higher speeds than the corresponding synchronous speed, so that if they are driven by three-phase A.C. motors they are not being used to the best advantage, and if a D.C. motor were used the motor-generator set could be run at a higher speed, and thus the capital cost of the reversing rolling-mill plant could be reduced.

The electrical drive of the live roller gear requires careful consideration, for if live rolls cannot be handled rapidly a good output cannot be obtained from the mill, however good it may be. The following considerations will show that live roller gear driven by D.C. motors can be handled more rapidly than if it were driven by three-phase motors.

The turning moment of the D.C. series motor varies with the square of the current, while that of the A.C. motor varies directly as the current. Therefore the D.C. motor can accelerate the live rolls much more rapidly than the A.C. motor. Conversely, in decelerating the live roller gear, the D.C. motor gives a much more powerful retarding effect than the three-phase motor, so that the former proves a more effective machine for reversing live roller gear than the latter.

Another disadvantage of the three-phase motor is that its turning moment is proportional to the square of the voltage, so that if the voltage falls, say, 10 per cent. the turning moment is decreased by 19 per cent. The turning moment of the D.C. motor is directly proportional to the voltage. This tends to make the three-phase motor sluggish where voltage variations occur.

In a certain large American steelworks where there is a large power house in the works generating three-phase current, direct-current live-roll motors have been installed throughout for this very reason, and the whole of the power for driving these motors is converted to direct current by rotary converters supplied for this purpose.

The cheapest way of obtaining power in iron and steel works is to utilise the blast-furnace and coke-oven gases, or other sources of waste heat, to the fullest extent. If these natural resources of the works are utilised in the most economical manner it will generally be found that they will provide all the power required by the works.

Where large low-speed alternators are driven by gas engines some peculiar resonance effects can be produced, and these have proved exceedingly troublesome in certain power houses. If the alternator be driven at a uniform speed by its engine, it can be set swinging, say, by a sudden overload or other causes, at its natural time of vibration about its uniform speed of rotation. If the alternator and flywheel are properly designed, these vibrations, when once started, will die away quickly. If, however, the natural time of vibration happens to coincide with the time which elapses between the successive working strokes of the engine or certain multiples of them, the vibration may become so violent that it is impossible to run the engine.

If a number of gas engine-driven alternators be running in parallel, serious difficulties can occur by the natural time of vibration of one of the alternators coinciding with the time between the working strokes of an engine driving another machine, so that it becomes impossible to run the two machines in parallel. The author has had experience of several cases of this kind.

To avoid the possibility of such resonance the proper weight of the flywheel has to be selected. Gas engine-driven D.C. machines are usually cheaper in capital cost than gas

engine-driven alternators, and have the advantage from the engineering standpoint that these resonance troubles do not take place.

Steam turbines directly coupled to three-phase alternators have been built in such large sizes and have proved themselves to be so reliable that they call for no special comment.

Direct-current turbo-generators with a high-speed turbine driving a comparatively slow-speed dynamo through some form of double-helical gearing have been built in sizes up to 6,000 kilowatts, and it is probable that natural development will lead to the construction of considerably larger sizes and that the turbines will run at higher speeds than 3,000 R.P.M., which is the highest possible speed of a three-phase, 50-cycle turbo-alternator. Such gear-driven sets have proved very reliable in operation, and from the engineering standpoint there is little to choose between three-phase and D.C. turbo-generators.

The capital cost of the D.C. geared turbo-generator is higher than that of a three-phase turbo-generator. The question to be decided, therefore, is what return the more economical application of direct current in the steelworks will make on the increased cost of the power house.

It has been shown that direct current should be adopted as the system of supply of a steelworks, and this leads to the consideration of the question of linking-up with power supply authorities which supply three-phase alternating current.

The following reasons have been advanced in favour of linking up:—

(*a*) That the power supply authority provides a standby to the works power house.

(*b*) That the power supply authority provides a possible market for the surplus power of the works.

It is evident that if a power supply authority undertakes to provide a standby of, say, 1,000 kilowatts, it must invest capital in an additional 1,000 kilowatts of plant in its boiler house and power station, and also invest a considerable capital sum upon its distribution system over and above the plant needed for its normal requirements.

The authority has capital, depreciation, and maintenance charges to meet on this additional plant, and must provide for a definite payment per kilowatt which it contracts to keep as a standby.

For the purpose of illustration, assume the capital cost to the supply authority of the plant and distributing system for providing 1,000 kilowatts standby to be £40,000. Then the power supply authority would make a minimum annual charge of the order of £6,000 to recompense it for out-of-pocket expenses—namely, capital, depreciation, maintenance charges, &c.—on the standby plant, whether this plant is used to supply power or not, and in addition if power is required from this plant it would make the ordinary charge per unit of electricity supplied.

The standby supply may be regarded as an insurance against exceptional circumstances. It is necessary for the works owner to assure himself that the power supply authority is carrying out its obligation by installing the plant necessary for providing a standby supply at any time.

It would appear better for works having blast-furnace gas, coke-oven gas, or other sources of power, to install their own standby plant rather than pay other people to do it. If they install their own plant and charge themselves annually a similar sum to that which they would be paying a power supply authority, the cost of the plant will soon be paid off. If, on the other hand, they rely upon the authority, this annual charge goes on perpetually.

In considering the second point, the question arises what price the power supply authority would be willing to pay for surplus power. A power supply authority is usually willing to pay 0.05d. per unit of surplus energy delivered to it by a works, and as on the other hand the authority usually charges about 0.5d. to 1.0d. per unit in selling its power to a works, the authority is apparently making a very substantial profit on any surplus power which it buys. If this be considered from the authority's point of view, it will be seen that surplus power is not of great value because, as a rule, it cannot be supplied when it is of value.

The works as a rule need the full output of their own power plant for themselves during the ordinary working hours of the day, and could only supply surplus power to the power supply authority at other times, when the authority does not need it, and when it is in consequence of little value.

It is evident, therefore, that the interests of the iron and steel works having their own power resources and those of a power supply authority do not coincide; there appears to be no advantage in linking-up with the power supply authority, and it would be more profitable to the iron and steel works to find a means for using their own surplus power, which is one of their valuable assets.

Protection against X-Rays.—At the Academy of Sciences, on May 27th, M. Daniel Berthelot announced that an important discovery had been made by Dr. Pech, which would ensure the protection of operators against the effects of X-rays. It consists of a process which neutralises the ultra-violet rays by the simultaneous application of infra-red rays.

WATER POWER IN SCANDINAVIA.

THE Council of the Swedish Water Power Association (Svenska Vattenkraft Forening), reporting to the members at the tenth annual meeting, held in Stockholm, on May 27th, stated that the active interest manifested in the utilisation of the national water powers during the years of war slackened somewhat during the past year. In explanation of this fact it was mentioned that the construction of hydro-electric works, and the prosecution of the electrification of the country districts, were proceeded with at a slightly slower rate in 1919 than in the preceding years owing to the decline in the period of prosperity in certain districts and "the increased supply of fuel oil."

Mr. Sven Lubeck then discussed the present situation of the question of power and fuel supplies. At present, he stated, the water powers already in service represent 1,150,000 turbine horse-power, whilst plant for a further 250,000 H.P. is in course of construction. The normal imports of pit coal at the beginning of the war ranged from 5,000,000 to 6,000,000 tons per annum. On the assumption that further water power representing 2,000,000 H.P. is brought into use within a period of 40 years forward, corresponding to 50,000 H.P. per annum, and allowing for normal development of consumption, it is calculated that it will afterwards still be necessary to import 5,725,000 tons of fuel per annum, including 250,000 tons of crude oil, petroleum, and benzine. In the opinion of the author, the hydroelectric industry is confronted with three principal problems: (1) The rational utilisation of available water powers by the regulation of the lakes and profiles; (2) the electrification of the country in connection with the economic distribution of power on a systematic basis; and (3) the facilitation of the industrial use of the Norrland water powers. In judging the question of economy in power, it is submitted that consideration must be given to the circumstance that after years of normal development the water powers in the South and in Central Sweden have practically all been brought into use. The solution of the power question in different parts of the country must gradually take place by the exercise of the greatest possible economy in the water power resources, the uniform regulation of the waters, the provision of reserve stations at appropriate places, particularly along the coast line, the use of peat, and the supply of power from the more richly endowed district of Norrland, and possibly also from Norway in the course of time. Indeed, the author is of opinion that some of the Norwegian water powers in future may find use in connection with Swedish interests to the advantage of both parties. At present hydroelectric power finds an increasing use in the Swedish wood and iron and steel and textile industries, but more particularly in the electrochemical industry, and the future prospects for the use of the power lie chiefly in the electrochemical and electrometallurgical branches.

The second contribution to the meeting was made by Mr. Ingvar Kristensen, director of the Norwegian waterfall administration, who dealt with the question in relation to Norway. Leaving falls of less than 1,000 H.P. out of consideration the author mentioned that the available water power represents 12,000,000 to 13,000,000 turbine H.P. per annum, of which only 1,400,000 H.P. is being utilised. The Government has purchased water powers amounting to 2,000,000 H.P. in different parts of the country so as to be able to have power available in connection with the conversion of the railways and the general supply of power, and for other public purposes. In fact, by this means and by the revision of the legislation concerning water courses and the strengthening of the water administration, the State is able to exercise a regulating influence over the use of water powers, which can now only be utilised on the grant of a State concession for the purpose.

GAS ON TRAINS.

WE recently mentioned briefly the report of a collision on an Indian railway, which was followed by a fire in which many people were burned to death. Particulars have been published in the *Pioneer Mail* of April 30th from which we derive the following details:—

The collision occurred near Mewa Newada station, Oudh and Rohilkhand Railway, near Moradabad, between an express and a goods train. Two vehicles at the rear of the goods train were smashed. Two vehicles at the rear of the goods gas fitted, were smashed and burned.

The accident occurred at 2.30 a.m. on April 26th.

The first three bogie carriages were completely smashed, and with the bursting of the gas-holder, caught fire. All the carriages were overcrowded, and among the passengers were three Hindu marriage parties and 50 Gurkha soldiers. Of the former only three, and of the latter only four, are reported to have escaped. All the rest were either killed outright or burned to death. The first bogie was a third-class and the

second an inter-class; the third was half full of men and half full of women passengers. Few of the women and children came out alive. Sixty-two wounded were brought to Moradabad in a relief train.

An eye-witness gives a heartrending account of the sufferings of those who were killed, burnt to death, or wounded. Most of the wounded went without any medical aid for ten or twelve hours, until they were admitted to the hospital.

Professor W. G. P. Wall, of the Training College, Allahabad, gave the following details:—

There were only four Europeans in the carriage in the centre of the train. So far as the Indian passengers (mainly third-class) were concerned, the train, unhappily, was crowded.

Professor Wall was awakened by a violent shock, and was first out of the train to see what had happened, closely followed by other Europeans. The train was at a standstill, and the first portion was even then blazing furiously. They ran along the train, and as they ran they saw an Indian running across a field with his clothes on fire. They extinguished the flames, but the man was so terribly burnt that he died a few hours later.

They then hurried to the wrecked carriages, where the sight which met them was a terrible one. The day had been very hot and dry, and all the woodwork was like tinder. The collision must have shattered the gas cylinders under the third-class carriages, and when the gas caught fire all the wreckage burnt rapidly and inextinguishably.

Meanwhile, the dry wind which had been blowing seemed to increase greatly in strength and carried the flames along the train. Most of the passengers succeeded in escaping out of the third bogie with slight injuries, though the bogie itself was burnt; but in the first two bogies the majority of the passengers were pinned under the heavy tangled wreckage, from which it was impossible to extricate them.

After the European passengers, with two or three Indians who rendered eager and useful help, had pulled out all the injured who could be reached, there were still a large number of sepoys in the first carriages and men, women and children in the second bogie, caught under bent steel framework or woodwork, who could not be brought out.

They could be seen struggling vainly with the flames rapidly spreading towards them, but nothing could be done. "I could not sleep last night," said Mr. Wall, "because of the memory of it."

We do not wonder at this; it is painful enough to imagine the scene without having witnessed its horrors. When will the use of gas on trains, with the frightful possibilities by which it is accompanied, be abolished? It is like carrying live shell with the safety devices removed—but worse, for instantaneous destruction is vastly preferable to the mental torture of the approaching flame, followed by the physical agony of roasting to death.

THE MID-LANCASHIRE ELECTRICITY DISTRICT.

The Electricity Commissioners, as briefly stated in our last issue, have taken their second step under Sec. 5 of the Electricity (Supply) Act, 1919, this time with reference to the re-organisation of electricity supply in part of the county of Lancaster, by the issue of a notice that they have provisionally determined that the undermentioned area shall be constituted a separate electricity district for the purposes of the Act, that is to say: The county boroughs of Blackburn, Blackpool, Burnley, and Preston; the boroughs of Accrington, Bacup, Chorley, Clitheroe, Colne, Darwen, Haslingden, Nelson, and Rawtenstall; the urban districts of Barrowford, Brierfield, Church, Clayton-le-Moors, Croston, Fleetwood, Fulwood, Great Harwood, Kirkham, Leyland, Longridge, Lytham, Oswaldtwistle, Padiham, Poulton-le-Fylde, Preesall, Rishton, St. Annes-on-the-Sea, Thornton, Trawden, Walton-le-Dale, and Withnell; and the rural districts of Blackburn, Burnley, Chorley, Clitheroe, The Fylde, Garstang, and Preston; which area is more particularly delineated on the accompanying map.

Objections or representations may be made on account of the inclusion of any area in, or the exclusion of any area from, the district so provisionally determined, and all such representations must reach the offices of the Commissioners not later than September 30th, 1920.

Map of Proposed Mid-Lancashire Electricity District.

Notice is to be given of the date of the proposed inquiry.

It will be noted that the two notices have again, as in the case of the Lower Severn District, been issued in one document, which may be taken as a desire to concentrate and curtail the proceedings.

In contrast to the first provisional district, the present area is a thickly populated industrial one. Except for the western boundary of the district which follows the sea coast, the boundaries are not marked by any topographical features. On the east and north-east the county boundary is followed, while on the north and south rural district boundaries mark the limits.

Blackburn and Preston form the centre of the area, and it is in these two adjacent districts that the two largest generat-

It being apparent to the Electricity Commissioners that the existing organisation for the supply of electricity in the district so provisionally determined should be improved, notice is further given that they intend to hold a local inquiry into the matter, and any authorised undertakers as defined in the Act may, before September 30th, 1920, submit a scheme for effecting such improvement in organisation, including the formation of a Joint Electricity Authority for the district, and any proposals for altering or adjusting the boundaries of the district so provisionally determined.

ing stations will in all probability be located, indeed the building of one of them has already been commenced.

Several of the larger electricity supply undertakings included in the district are in urgent need of extension of their plant, and a commencement has already been made on such work in some instances. It will be remembered that the foundation stone of the new Whitebirk station at Blackburn was laid last month. This enterprise will cost about half a million sterling, and there is ample scope for future extension. The initial installation will comprise two 10,000-kw. turbo-alternator sets generating at 6,600 volts three-phase, and it is hoped to have one set in operation by the end of this year. The station is in close proximity to railway and canal; there is also a large quantity of peat on the site, and a Scandinavian expert has reported favourably on its use as a fuel. Mr. P. P. Wheelwright, engineer-in-chief, may also have considered the feasibility of the use of gas from the Greenbank gasworks as a fuel should circumstances necessitate such a course. A second new station will very likely be established in the area. This will probably be commenced next year on the south bank of the Ribble at Preston, where a dam is proposed to be constructed. A link between the Preston, Blackburn, and Burnley stations is also contemplated, and the latter undertaking is proposing to borrow £150,000 to cover the cost of extensions that are needed. In April the chief engineer at Burnley reported on the extensions required in the undertaking, and the proposed linking up with other undertakings in connection with the establishment of the area. Nelson contemplates the expenditure of over £152,000, and tenders for part of the extension were accepted in February last. At Blackpool new plant is also to be installed and negotiations have taken place between the Corporation and the Fylde Water Board, upon which, in the event of the present works being extended, the Corporation will be dependent for an adequate supply of water for condensing purposes.

The whole of this activity has taken place this year, but the demand for electricity is increasing to such an extent, owing to the electrification of mills and factories, &c., in the area, that most of the additional output that will be available when the various extensions are completed has already been fully booked up.

To make a prediction in conclusion, the next area to be provisionally determined will most likely be that of the North-West Midlands in the Black Country. Such an area would include the two proposed large stations at Stoke and Rugeley on the river Trent, and that at Ironbridge on the Severn. This district would embrace Staffordshire, with the important stations existing at Wolverhampton, Walsall, Tipton, West Bromwich, and Stourbridge; part of Shropshire, including Shrewsbury; and part of Cheshire, including Crewe. Moreover, it would lie between the two areas that have already been defined on the south and north.

An Electrically-Propelled Ferry.—Sketches were recently published by the *Pacific Marine Review* of a double-deck ferry boat 191 ft. long by 44 ft. beam; the propelling machinery consists of two Diesel engines driving dynamos which in turn supply a motor directly connected to the paddle wheel shaft, and in order to ensure efficiency at a low rate of revolution, the motor is made of large diameter.—*Technical Review.*

ELECTRIC FURNACES.

The electric furnace, which by reason of its cleaner and more economical working is still finding more and more favour in the eyes of the metal industries, is rapidly extending its field. The Leeds Electrical Construction Co. has recently supplied us with details of its products, which include furnaces of many types for various employments, and some of these are now described. The heat treatment of carbon and special steels to be a success requires above all a method of adjusting and maintaining temperature within very fine limits. By the use of an electric furnace this is assured to a reasonable degree of accuracy. The special type manufactured by the company for this purpose is the R.M.D. rotary furnace, an illustration of which is given (fig. 1). This is of the resistance type, the furnace chamber being constructed of special refractory material to withstand a maximum working temperature of 1060 deg. C., and possessing high thermal conductivity and a low coefficient of expansion. The chamber containing the heating element is effectively heat insulated from the outside case of the furnace by material of low conductivity. The energy is conveyed to the heating chamber by means of phosphor-bronze slip-rings mounted on a refractory extension of the chamber, and the connections are enclosed in a cast-iron protecting cover. The furnace is encircled by a worm-wheel which engages with a worm on a shaft rotated by a small motor. This motor and the heating element are connected in parallel, so that when the motor is switched off the heating energy is also cut off. The control panel includes a thermostat and cut-out which can be set to switch the power on or off within limits of a few degrees. The current through the heating element is adjusted by means of the resistance shown in the illustration. Another type of rotary furnace suitable for heating rivets is built on similar lines, and is supplied either for stationary work or as a portable unit; in the latter case it is the usual practice to mount the furnace on a trolley. In this set the motor-shaft, ending in a worm, engages directly with the wheel encircling the body of the furnace, and the rotation automatically produces travel of

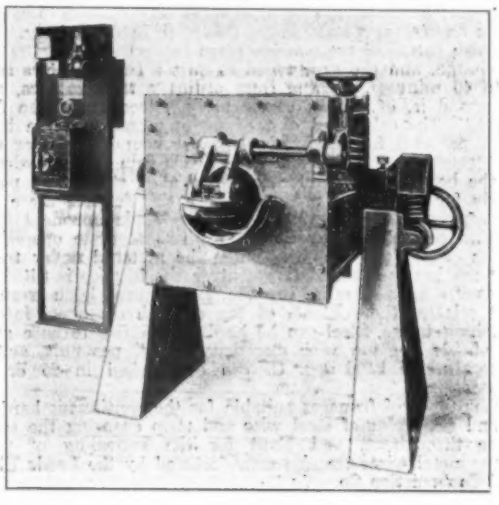


Fig. 2.—Electric Tilting-Furnace (Tilted).

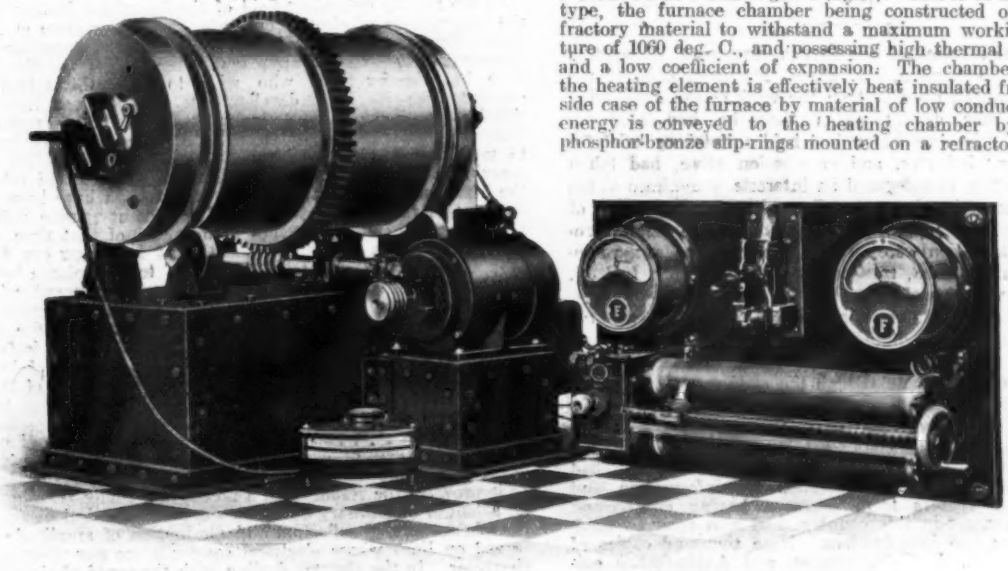


Fig. 1.—Electric Rotary Furnace.

the rivets through the furnace. The rivets are fed into one end of the furnace, and the speed of output at the other end is adjusted to suit the various sizes. A notable feature of this furnace is its portability, as owing to its size, roughly 2 ft. × 2 ft. × 1¼ ft., the complete equipment can be located in the hull of a ship and other parts generally difficult of access. It is stated that the total energy consumption of this type, when heating ¾ in. diameter rivets at the rate of four per minute, is three units per hour, including the necessary power for the motor. Tilting furnaces such as that shown in fig. 2 are also among the manufactures of this firm. The furnace illustrated is primarily intended for the melting of aluminium, brass and other non-ferrous metals, and is of the resistance type. The metal is contained in a chamber possessing a non-oxidising atmosphere, and there are no products of combustion to be dealt with. The temperature is under control, and the metal can be poured at any definite predetermined degree most suitable for the work in hand. The sizes in which this type are manufactured range from 50 to 300 lb. per charge, and the time taken to melt a full charge is from 35 to 40 minutes, starting from ordinary temperatures, and the period is, of course, considerably reduced after the first "heat." The calculated cost of melting brass, on the basis of 1d. per unit for energy, is .12d. per pound. Another tilting furnace manufactured by the Leeds firm is one designed for the heat treatment of carbon and alloy steels, and particularly for use in tool production. In this furnace there are two separate heat chambers, each under independent temperature control, and by this means two separate operations can be carried out at once. When the material under treatment reaches the desired temperature the furnace is tilted by means of a hand-wheel at the side, and a spring latch arrangement releases the contents of one or both chambers into a quenching tank. Steel can be hardened in this furnace at a cost of 32s. per ton with electricity at 1d. per unit, and a temperature of 1,000 deg. C. can be reached in 25 or 30 minutes.

Other types of furnaces suitable for the continuous hardening and tempering of steel wire and strip ensuring the same degree throughout, and plant for the annealing of non-ferrous metal wires are also manufactured by the Leeds Electrical Construction Co.

THE BRITISH ENGINEERS' ASSOCIATION.

At the annual meeting of the British Engineers' Association recently held in London, Mr. D. A. Bremner, O.B.E., the Director, submitted his report on the work of the Association in the past year, during which time he had held his appointment. The Association had held a watching brief for the engineering industry, and as occasion arose, had taken appropriate action to safeguard its interests, sometimes alone, and sometimes acting in conjunction with the Federation of British Industries and other organisations. The matters receiving such attention were: Import, export, and anti-dumping legislation, taxation, transportation, coal supply, fuel oil, petrol, standard forms of contract, and Board of Trade statistics. Considerable attention had been devoted to the development of the utility of the Trade Inquiry, Inspection, and Information Bureau. The offices had been extended to provide for its expansion, and though the staff was a small one, they were able to deal with communications in eight foreign languages. From May, 1919, to March, 1920, 693 trade inquiries were sent out to the appropriate groups of members. Foreign embassies, legations, banks at home and abroad had frequently applied to the Association for information and assistance, and visitors from overseas, having engineering business to transact in this country, had also received helpful information and introductions. Nine thousand copies of the Anglo-Spanish, Anglo-Portuguese, and Anglo-Italian editions of the B.E.A. official directory of members had been dispatched to carefully selected addresses. The 1920 directory would be an all-English edition for circulation at home and in English-speaking countries overseas. Mr. Bremner referred to the reports that had been sent home by Mr. G. C. Sanderson, the Association's special commissioner in Brazil. Sixteen reports had already been circulated to members, and others were to follow. He had sent home privately a good deal of valuable information relating to Brazilian trade matters. Reports were now coming forward from the West Coast of South America, from Capt. R. T. Hird, their special commissioner for Chile, Peru, and Bolivia. In many matters the Association acted in close co-operation with the F.B.I., the National Union of Manufacturers, the British Commonwealth Union, the Industrial League and Council, and National Propaganda. An intensive recruiting campaign was in progress which should lead to an increase in the membership, which was now 580, as against 539 a year previously. A number of members had increased their voluntary assessments for subscription, but the Association must further increase its income or it could not develop.

The annual meeting, held on April 29th, was presided over by Col. O. C. Armstrong, D.S.O. Among other points referred to by him was the burdensome nature of the Corporation tax. After the deduction of fixed interest bearing charges, the whole tax of 1s. in the £ on the total profits would be borne by the ordinary shareholders, and in many cases it might amount to 2s. in the £ on the profits divisible among them, thereby reducing their dividend by 1 per cent. The corporation tax was therefore a more serious matter than would appear at first sight. Later speeches emphasised the need for members to support the Association in its work and in obtaining new members. A resolution was passed recording an emphatic protest against the continuance and increase of the excess profits duty. Mr. Bremner referred to the need for members to strengthen the organisation in every way possible, making it more representative and therefore more powerful, placing at its command the financial resources necessary to make it really effective. Their policy was to serve their members, who were all busy men, rather than to call upon them to sit on innumerable committees, coming up to town from time to time to attend meetings, and more or less dissipating their energies which might be much more usefully applied at their own seat of wealth production. He and the B.E.A. staff were the people who should do the work. In sending out communications their difficulty was to get at the men who mattered; it was difficult to get past the office boy. They were, with that in mind, limiting the number of their communications to those that appeared to be really justifiable to the minds of business men. Mr. H. Allcock referred to the fact that they had in the B.E.A. a weapon to carve their way into the markets of the world. "We want that weapon to be kept bright and sharp and clean and strong, so that when we need it we shall find that it has not rusted in the meantime."

REVIEWS.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By J. A. FLEMING, M.A., D.Sc., F.R.S. Third edition, revised and extended. London: Messrs. Constable & Co., Ltd. Pp. xiv+370, figs. 19. Price 21s. net.

In the rapidly extending field of the literature dealing with the propagation of electric currents, this new edition of Professor Fleming's work will be given a cordial reception by those not only who are approaching the subject for the first time, but also by those who wish to keep themselves *au courant* with its later developments. When the lectures, which formed the basis of the work, were first delivered at University College in 1910-11 the utter hopelessness of trying to take notes and at the same time intelligently follow the amazing rapidity with which Dr. Fleming filled and refilled the blackboard with mathematical proofs, must have been felt by most of those who attended. The present volume will go a long way to supply the gaps in the notes of that time, and in other respects to amplify them. It is a long cry from "Short Lectures to Electrical Artizans" to the volume before us, but the same clarity of expression of treatment which characterised the author's early work is still conspicuous in his latest. The distracting mistakes which marred the first issue of the work have been rectified, and the reader is fairly safe to begin the perusal of the book without fear of being arrested by misleading expressions for the value of $\tanh (a+jb)$ or of that for $\int_0^{\tau} \sin pt\, dt$.

Of the later additions to the original volume, the chapter on the vibrations of loaded strings and their analogies with loaded telephone cables is particularly interesting, inasmuch as it provides the reader with a means of actually reproducing on a length of ordinary string by simple mechanical means all the phenomena of reflection and diminution of amplitude observed on lines whose electrical constants are non-uniform in character. In the chapter dealing with the speed of signalling in cables reference is made to the "cable constant," which is defined as the product of the capacity of the cable, its resistance and the letters per minute which can be sent through it. This, however, is a very arbitrary quantity, which has already been badly upset by such delicate receiving instruments as the Orling and Heurtley relays, to say nothing of the possibilities inherent in the modern amplifier.

The method and description of the Fleming-Dykes capacity bridge for the determination of capacities at any temperature and frequency, as well as the dielectric constant and specific conductivity, is interesting. Values are given for the ratio S/C for various cable dielectrics.

A brief description, with diagrams, is furnished of the Franke alternator for the measurement of the attenuation constant of cables, and a fairly lengthy outline of present day practice in the use of loaded cables and loaded aerial lines.

The remaining chapters deal mathematically with the effect of leakance on loaded cables, the predetermination of the constants S/C and R_1/L_1, and on reflection losses at their junctions.

A. F.

Machine Drawing for Electrical Engineers. By EDWARD BLYTHE, A.M.I.E.E. Pp. 81; 18 plates. London: The Cambridge University Press. 21s. net.

Text books on machine drawing for mechanical engineers are innumerable, and many excellent works have been published; for some reason, however, very little has been done in this direction for electrical engineers and students.

In the majority of Technical Institutes and Engineering Schools, electrical students take the ordinary course of instruction in mechanical engineering detail, very little effort having been made to specialise in electrical engineering details.

The great development in recent years in the science of electrical engineering and the important part that this branch of engineering will play in the future, demand suitable text books. The above work is an excellent attempt to fill the gap which undoubtedly exists, and is the outcome of the experience of the author, both as an electrical engineer and a technical teacher.

The author has presented a number of systematical progressive exercises, which lead the student through the elementary stages of projection of simple pieces of apparatus, to the preparation of drawings of a similar nature to those found in the modern workshop, and it has been attempted to familiarise him with the method of constructing and reading workshop drawings dealing with purely electrical fittings and detail.

It is pointed out that from contact with pupils in the drawing office, the author has found that most beginners encounter considerable difficulty in forming anything like a clear conception of the construction of an object, from the plans elevation and section executed on the orthographic projection principle, and for that reason small isometric or perspective views have been inserted, with the object of affording assistance in overcoming that difficulty.

The illustrations in the book are large and clear, and are first-class examples of draughtsmanship. The various examples have been selected with the view of illustrating not only the fundamental principles, but also modern types of electrical apparatus. The book will be of great use for teaching purposes in Technical Institutes, and also to all those engaged in preparing electrical drawings. It is a well-thought-out and excellently arranged work, and will have many imitators in the near future.

E. P.

The Management Problem. By EDWARD T. ELBOURNE. London: The Library Press, Ltd. Pp. xi+144+24. Price 4s. 6d. net.

This book is one of those included in the Manufacturing Problem Series, of which series the author is the general editor.

It opens encouragingly enough by saying that while there is to-day great talk of the relations between capital and labour there is too little talk of the connecting link—management. Our readers are already aware that we have lately devoted a good deal of attention, in our editorial columns, to various aspects of industrial relations, and we had hoped to find that Mr. Elbourne's book was one which we could recommend to their notice as carrying the matter further at a single journey than is possible in a weekly paper. The limitations of space, and the demands made upon it by other topics of current interest and importance, exercise inevitable restraint in the case of the periodical; while the book may be expanded to any reasonable length required to carry its subject to a definite point.

We were, therefore, sorry to find, on proceeding with the book, that except for the opening sentence and a passing reference to the unwisdom of management in acting almost entirely as the agent of capital, whereby the distrust of labour had been aroused, it rapidly degenerated into a dissertation on the handling of the workpeople at a factory at Ponders End. Certain general conclusions are drawn from the war-time experience obtained there, but the whole book can best be described as an expression of the author's views and opinions on the right way to run an employment department.

Of the relations between capital and management, management and labour, in their various spheres, we find no helpful word, and of the duty of management to itself no word at all. There is still room for someone to deal at length with this last problem, and it should be done quickly. If management, or, as we have called them, the trained brain workers, will get properly into their place in industry, they will be able to contribute more to the solution of industrial problems than either capital or labour. The management problem is, for this reason, quite the most urgent of all at the present time.

Electricity. By R. E. NEALE, B.Sc., A.M.I.E.E. Pp. viii+136. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

The aim of this book is to review in a simple way "the general nature of electricity, the methods of producing it, and the services to which it is applied." This forms a rather formidable task, but on the whole the author succeeds remarkably well. He starts off with a chapter on the "sources of electricity" and "kinds of current." This chapter is the weakest part of the book, but those which follow amply compensate for it. A vast amount of useful information is packed into the 136 available pages, and where fundamental principles are dealt with they are clearly and convincingly stated. The author uses arithmetical values to illustrate practical applications at every opportunity, and these should be useful in fixing the ideas of the class of reader most likely to use the book. Chapters VII, VIII and IX, dealing with domestic applications of electricity, are very valuable, and supply authorities would do well to disseminate the information contained therein amongst their consumers. The chapter on electric welding and cutting (No. XIII) is particularly interesting, and is quite up to date. It is singled out for special mention, as its very suggestiveness brings into prominence one of the few serious failings of the book, namely, the lack of references to works on special subjects. Another useful addition would be a short glossary of the technical terms, as it will be impossible for the average reader to get full benefit from the book without this. It would also be advisable to state definitely the relation between the standard units of heat and of electrical energy, as this would provide an absolute base for all the figures quoted relating to costs of electrical processes. The literary style of the work is well up to the usual standard of scientific books, although the value of effusions such as "electrical energy is employed in many forms and degrees between which there are distinctions analogous to those between the mountain and the grain of sand, the precipitous ravine, the undulating foothills and the plain," is not apparent to the reviewer. There are few actual mistakes—kilowatt-amperes (p. 39), within, for with (p. 40), the rectifiers . . . *yield* high efficiency (p. 44) being the most glaring. The illustrations as usual are drawn from the catalogues of manufacturers, but this is not very objectionable considering the object of the book, and the author takes the unusual course of honestly acknowledging their source in all cases. Generally they are good, but fig. 17d is almost valueless. The idea of fig. 13, which shows the principal features of a generating and distribution system, is good. The execution is, however, only mediocre. The printing and binding of the book are excellent, and it can be recommended to all who wish to acquire an intelligent view of modern electrical practice without going deeply into any special part.

C. W. M.

Flow and Measurement of Air and Gases. By ALEC B. EASON, M.A., A.M.I.E.E. Pp. xii+251, figs. 56. London: Charles Griffin and Co., Ltd. Price 25s.

A perusal of this book gives rise to two outstanding impressions, the one a feeling of admiration for the great and painstaking industry of the writer; the other a realisation of the extreme difficulty in arriving at even an approximate generalisation of the laws of flow of gases in pipes.

Whatever formula is adopted, the varying value of the coefficient of friction militates against reliability in practical applications. Mr. Eason fully realises this. He still makes a brave effort to produce order out of chaos, and in Chapter II, after an examination of formulæ of various authorities, gives figures for the value of the coefficient of friction applicable to different classes of work. These no doubt offer a working compromise.

The chapter dealing with loss of pressure in fittings breaks no new ground, and again emphasises the conflict between the values of losses given by various authors.

In his treatment of pneumatic tube problems the author displays a ready familiarity with the subject. There is a not unwelcome lack of that copious quotation of authorities which marks the greater part of the book.

Fig. 4.1 connecting quantities of air used, velocities of air and transit times is particularly interesting. Its usefulness, however, would be enhanced by an account of practical experiments made by the author to test the accuracy of the curves.

One would have liked to see the theoretical aspect of various types of meter supplemented by illustrations and sketches of actual meters, with some remarks upon their practical behaviour. In this connection, the author mostly draws attention to the excellent paper, by Hodgson, on the commercial metering of air, gas, and steam, read before the I.C.E.

In the last few chapters of the book, a return is made to the mathematical disquisition upon the work of various experimenters, only the briefest mention being made of practical matters. Mr. Eason has given us an able summarised mathematical compilation of the work of various authorities. His contribution to the literature on the subject of gas measurement and flow pressure will, however, be regarded by the average engineer as academic. To the designer, the book will prove of value. The curves are well drawn, but would be more valuable if accompanied by fuller explanations, without recourse being necessary to the context.

Two good features of the book are the list of reports, books, and authorities consulted, and, at the end of each chapter, a summarised explanation of the symbols used.—T.W.

The Costing Problem. By EDWARD T. ELBOURNE. Pp. 138. London: The Library Press, Ltd Price 4s. 6d. net.

This book contains, in addition to the author's remarks, extracts from the cost-finding system of the Federation of Master Printers of the United Kingdom of Great Britain and Ireland; Federation of British Industries' Report "Commercial Efficiency," and Lieut.-Col. O'Meara's paper on "The Functions of the Engineer."

Chapter I, "The necessity for costing," deals with certain fundamentals, the relationship between capital and labour, the technical use of costs for establishing production efficiency, which the author states is an instrument of management that has been sadly neglected. Scientific management as practised in America evidently does not appeal to the author, who states that "it cannot be said to give much inspiration to us in this country; it is our privilege and responsibility to work along different lines." This statement is rather difficult to understand, as most of these works on scientific management deal very thoroughly and minutely with the very subject the author chooses for his title.

Chapter II, "All-in Costs," deals with the well-known principles of allocation of costs between prime cost and production "on cost," &c.

Chapter III, "The Functions of Factory Accounts," is self-explanatory.

Chapter IV, "Approximation in Factory Accounting," deals with the distribution of burden charges, &c.

Appendix A, extracts from the Federation printers' cost-finding system, is an example of an up-to-date system, and it is not the first time printing trade costing systems have been quoted in works on costing.

Appendix B, extracts from report of Committee on Commercial Efficiency appointed by Federation of British Industries, dated September, 1918, dealing with fundamentals of costing, is a valuable general treatise. The work concludes with an extract of that very able paper "The Functions of the Engineer: His education and training," by Lieut.-Col. W. A. J. O'Meara, C.M.G., which was read before the Institution of Electrical Engineers in February, 1919. Although this work does not contain anything that has not already been dealt with previously in quite a number of works on costing and scientific management, the book, with many more of its type, is welcome, inasmuch as they emphasise the necessity of ascertaining "true costs of production," which is a *sine qua non* if British industry is to compete successfully in the world's markets.

J. C. P.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,137. "Amplification of telephone currents." T. F. Wall. May 25th.

14,172. "Dynamometers." Heenan & Froude and G. H. Walker. May 25th.

14,179. "Insulating fish-plates from rails in electric railway track circuits." T. Hardiman and T. J. Wheeler. May 25th.

14,186. "Electric projector lamps for motor-vehicles." A. J. Curnow and Howes & Burley. May 25th.

14,224. "Control of dynamo-electric machinery." D. P. Alexander. May 25th.

14,268. "Machines for laying-up or twinning conductors for dry-core, &c., cables." W. T. Henley's Telegraph Works Co. and H. Savage. May 25th.

14,290. "Electric systems containing X-ray, &c., apparatus." H. Pilon. May 25th. (France, August 19th, 1915.)

14,309. "Electric heating apparatus." D. Corsi. May 25th. (France, February 7th, 1919.)

14,313. "Electric soldering-irons." R. K. Hearn. May 26th.

14,318. "Railway signalling systems." Automatic Telephone Manufacturing Co. and A. E. Hudd. May 26th.

14,321. "Distributors for high-tension electric currents." A. Kirk. May 26th.

14,333. "Electric conduit fittings." M. J. Railing and T. Taylor. May 26th.

14,348. "Electrical magnetic self-driving power unit." F. Read. May 26th.

14,354. "Means for regulating speed of electrically-driven rolls on paper-making machines." A. L. Boyle. May 26th.

14,357. "Sound amplifier." P. R. Gossky. May 26th.

14,360. "Dual ignition for starting internal-combustion engines." H. A. Savage. May 26th.

14,361. "Dynamo-electric machinery." H. K. Whitehorn. May 26th.

14,410. "Electric switches." F. E. Williamson. May 27th.

14,414. "Electrical cut-out." W. H. Illingworth. May 27th.

14,415. "Electrically-heated kettles, &c." W. W. Soutter. May 27th.

14,433. "Electric starting and regulating switches." G. O. Donovan. May 27th.

14,469. "Fuses for protecting electrically-heated utensils from over-heating." E. G. Nicholson. May 27th.

14,500. "Electric accumulators." A. Pouchain. May 27th.

14,509. "Electro-magnets." G. C. Cummings. May 27th.

14,514. "Controllers for electric motors, &c." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). May 27th.

14,531. "Sparking plugs." W. & W. H. Gold. May 28th.

14,536. "Starting devices for motor-vehicles." A. E. C. and W. Benson. May 28th.

14,541. "Motor-starters, rheostats, &c." L. K. Vibr. May 28th.

14,542. "Electrical switch control mechanism for trucks, &c." H. J. Carey. May 28th.

14,543. "Means for suspending bowls, shades, &c., for electric lights, &c." B. Richardson. May 28th.

14,548. "Electric switches for lighting-sets of motor-vehicles." J. Eaton and Efandem Co. May 28th.

14,565. "Electric switches." Horstmann Cars, Ltd., and S. A. Horstmann. May 28th.

14,571. "Electric railway, &c., track systems." N. Prior. May 28th.

14,587. "Sparking plugs." J. Baker, W. C. Bayliss, H. W. Merrell and A. L. Wood. May 28th.

14,590. "Telephone exchange systems." Western Electric Co. May 28th. (United States, July 22nd, 1918.)

14,599. "Variable electric condensers." A. W. Isenthal. May 28th.

14,604. "Short-circuit terminals for magneto-ignition apparatus of internal-combustion engines." Scintilla. May 28th. (Switzerland, May 28th, 1919.)

14,630. "Electric burglar alarms." W. Doms. May 28th. (Germany, April 11th, 1918.)

14,636. "Dynamo-electric machinery." Metropolitan-Vickers Electrical Co. and M. Walker. May 28th.

14,639. "Electric cables and terminals therefor." British Lighting & Ignition Co. and E. O. Turner. May 28th.

14,652. "Induction electricity supply meters." A. Schuster. May 29th. (Germany, August 15th, 1918.)

14,669. "Electro-magnetically operated plate or bar handling skids." D. Colville & Sons and J. J. Inglis. May 29th.

14,672. "Reflection of high-tension alternating currents." Soc. Anon. des Etablissements H. Pilon. May 29th. (France, April 9th, 1919.)

14,679. "Modulation systems for wireless signalling, &c." Radio Communication Co. and J. Scott-Taggart. May 29th.

14,680. "Vacuum tube relay devices, &c., for wireless signalling systems, &c." Radio Communication Co. and J. Scott-Taggart. May 29th.

14,683. "Wireless receiving apparatus." C. K. Chandler. May 29th.

14,687. "Terminals for electric conductors." G. H. Sykes. May 29th.

14,703. "Wireless receiving systems." N. Lea and The Radio Communication Co. May 29th.

Correction.—For the reference under No. 13,185 in our issue of May 28th the following should be substituted: 13,185. "Device for bonding and linking up steel tubing of electrical installations." A. E. Ryeland & C. Ferguson. May 12th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

18,534. Alternating-current welding transformers. C. J. Holslag. January 14th, 9118. (142,521.)

1919.

46. Electric switches and switch fuses. F. G. Warburton. January 2nd, 1919. (142,523.)

65. Submarine telegraph cables. F. G. Creed. January 2nd, 1919. (142,524.)

2,761. Tools for slotting commutators. J. Gardner and C. Y. Knight. February 4th, 1919. (142,548.)

2,966. Electric heaters or radiators. A. Pritzkof. February 6th, 1919. (142,558.)

2,984. Memoranda or writing appliance for use in connection with telephones. J. M. Hattersley. February 7th, 1919. (142,559.)

3,419. Method and system for producing and selectively transmitting harmonics of electric oscillations. Western Electric Co. February 12th, 1919. (142,571.)

3,592. Gas-filled electric lamps. Edison Swan Electric Co. and P. Freedman. February 13th, 1919. (142,574.)

4,168. Rotary current collectors for electric machines. G. di L. Pestarini. February 19th, 1919. (142,578.)

5,387. Ignition devices for use in explosion motors. G. Caliano. March 4th, 1919. (142,593.)

5,706. Sparking plugs for internal-combustion engines. H. F. Holworthy. August 30th, 1919. (142,596.)

7,110. Antennæ for wireless-signalling systems. British Thomson-Houston Co. (General Electric Co.). March 21st, 1919. (142,610.)

8,901. Regulators for electric generators. British Thomson-Houston Co. (General Electric Co.). April 8th, 1919. (142,630.)

9,311. Junction boxes for electric cables. H. B. Smith and Callender's Cable & Construction Co. April 11th, 1919. (142,635.)

9,934. Switches for electric lamps. Clifford Bros. and J. Riddel. April 22nd, 1919. (142,643.)

9,994. Speed-control gear for electric motors, especially applicable for crane motors and the like. Vaughan Crane Co. and J. W. Stanley. April 22nd, 1919. (142,645.)

11,032. Electrical resistance and manufacture of same. G. Turnock. May 3rd, 1919. (Cognate application, 26,935/19.) (142,655.)

12,080. Electric horns. C. H. Offord and W. E. Parker. May 14th, 1919. (142,665.)

12,970. Means for measuring electric currents. M. B. Field. May 23rd, 1919. (142,673.)

13,058. Electric terminal connections. H. S. Cooke. May 24th, 1919. (142,674.)

13,627. Coil-winding machines. Igranic Electric Co. and S. R. Wright. May 29th, 1919. (142,680.)

13,628. Method of and means for applying the insulation of high-tension coils. Igranic Electric Co. and S. R. Wright. May 29th, 1919. (142,681.)

18,941. Sparking plug. D. V. L. Fellowes. July 30th, 1919. (142,716.)

19,378. Electric furnaces. E. F. Collins. September 21st, 1918. (133,026.)

19,459. Incandescent electric lamp sockets or holders. Benjamin Electric, Ltd., E. Fowler and R. A. Ives. August 7th, 1919. (142,717.)

19,599. Electrical apparatus for heating liquids. H. C. Sanders. August 8th, 1919. (142,719.)

23,659. Ceiling-roses and junction-roses for electric light and power installations. J. B. Tannahill. September 25th, 1919. (142,734.)

24,154. Sparking plugs for internal-combustion engines. C. F. Burton. October 3rd, 1919. (142,737.)

25,134. Sparking plugs for internal-combustion engines. G. E. Parker. October 14th, 1919. (142,741.)

26,036. Magneto-electric machines. British Thomson-Houston Co. and A. P. Young. October 23rd, 1919. (142,744.)

28,461. Electric couplings. W. E. Barber and E. Hoyle. November 17th, 1919. (142,754.)

29,532. Spark plugs. Marmon Chicago Co. December 16th, 1918. (136,811.)

32,013. Sparking plug for internal-combustion engines. E. Chasseraux. January 14th, 1919. (137,816.)

The E.T.U.—The *Daily Herald* states that no candidate having secured a clear majority over all the other nominees for the post of extra assistant general secretary of the Electrical Trades Union, a second ballot is to be taken this month on the names of W. M. Citrine and A. H. Stewart.